ROLLING BEARING WITH SENSOR

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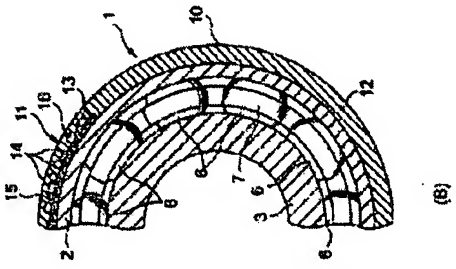
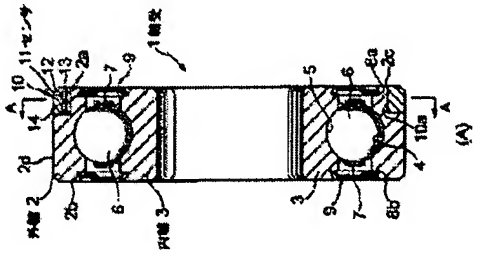
Abstract of **JP2002206528**

PROBLEM TO BE SOLVED: To provide a bearing with a sensor attachable to existing facility easily without applying special machining to a bearing mounting part of, for example, a bearing housing. SOLUTION: An annular groove 10 is provided in an outer peripheral fringe part on one side in the direction of width of an outer ring 2 which is one form of a bearing ring. The sensor 11 in which a detection part 15 and a circuit part 16 are mounted on a flexible printed wiring board 13 is attached in the groove 10. The sensor 11 is stored in a mold made of synthetic resin 12 provided by burying the annular groove 10.





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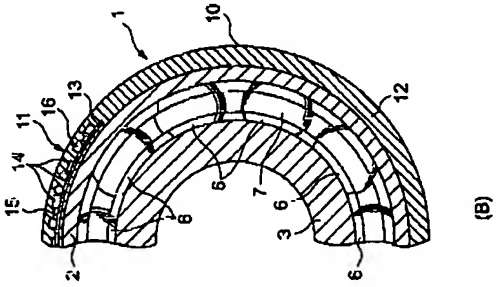
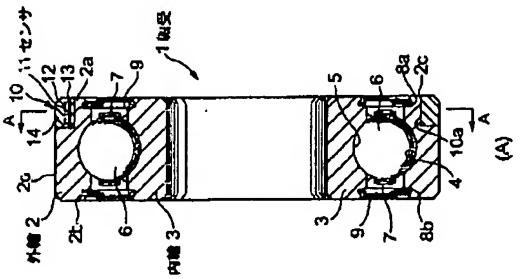
(54)【発明の名称】　センサ付き転がり軸受

(57)【要約】
【課題】本発明は、例えば軸受ハウジングなどの軸受取り付け部に特別な加工を施す必要がなく、かつ、既存の設備にも容易に取り付けられるセンサ付きの軸受を提供する
【解決手段】軌道輪の一形態である外輪２の幅方向片側の外周縁部に環状溝１０設ける。この溝１０内に、検出部１５と回路部１６がフレキシブルプリント基板１３に実装されたセンサ１１を取り付ける。環状溝１０を埋めて設けられる合成樹脂１２モールド内にセンサ１１を収容する。





【特許請求の範囲】
【請求項１】　内外の軌道輪と転動体とを備え、検出部と回路部がフレキシブルプリント基板に実装されたセンサを、前記内外いずれかの軌道輪にその周方向に沿わせて取り付けたことを特徴とするセンサ付き転がり軸受。
【請求項２】　シールドを備える転がり軸受であって、検出用の回路部がフレキシブルプリント基板に実装され、この基板を前記シールドに取り付けたことを特徴とするセンサ付き転がり軸受。
【請求項３】　内外の軌道輪と転動体とを備え、振動、または温度、或いは湿度の内の少なくともいずれか一つを検出可能な検出部と回路部とを備えたセンサを備え、前記回路部を内外いずれかの軌道輪にその周方向に沿わせて取り付けたことを特徴とするセンサ付き転がり軸受。
【請求項４】　湿度を検出する前記検出部は、前記内外軌道輪といずれかの軌道輪に支持される前記シールドとで囲まれる空間内に設けられることを特徴とする請求項１から請求項３のうちのいずれか一項に記載のセンサ付き転がり軸受。
【請求項５】　前記回路部が、前記検出部によって検出された信号を電波に変換して送信する電波発生部を有していることを特徴とする請求項１から請求項４の内のいずれか一項に記載のセンサ付き転がり軸受。
【請求項６】　前記回路部が、前記検出部によって検出された信号を超音波に変換して送信する超音波発生部を有していることを特徴とする請求項１から請求項４の内のいずれか一項に記載のセンサ付き転がり軸受。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、振動や温度や水分（湿度）などを検出するセンサが取り付けられた転がり軸受に関する。
【０００２】
【従来の技術】回転軸を支持する軸受は、回転軸心のずれによって振動を生じたり、回転摩擦によって発熱したりする。これらの振動や温度は軸受の寿命に影響する。また、産業用機械の中には、機械加工などで水溶性の切削用潤滑剤を使用する場合もあり、軸受部に水分を含んだしぶきがかかることもある。さらに、自動車、鉄道車輌及び建設機械などの屋外で使用される装置に取り付けられる場合は、雨が降ったり水溜りを走行するなどの場合に、水が軸受部にかかることがある。このような軸受部には、軌道輪と転動体の転接面を防錆するために、内外の軌道輪に摺動嵌合する例えばゴム性の耐水シールドを取り付けて防水措置が取られている。しかしながら、耐水シールド付きの軸受であっても、気象の変化、特に急激な気温の変化により、水分が耐水シールドの内側に水蒸気となって浸入し、軌道輪と転動体の転接面に結露を生じたりする場合もある。
【０００３】よって、特に装置の内部などの点検の難しい部分に取り付けられている軸受については、汎用品である振動センサまたは温度センサ或いは湿度センサなどを別途用意して、それを必要に応じて対象となる軸受の外周面に取り付け、検出信号を有線で出力している。
【０００４】
【発明が解決しようとする課題】しかしながら、これらの汎用センサは、形状的に大きいため、それを取り付けた軸受は、センサ部の大きな突出が配置上問題となりやすく、それを考慮して軸受ハウジングにも、センサ部を収容するための大きな加工やスペースを要する。
【０００５】また、既存設備の自動化などの場合、遠隔操作による設備の運転状況の把握は必須のものである。そのため、既存設備の軸受にセンサを取り付け、振動や温度や水分（湿度）などを検出するような場合に至っては、軸受周りの大掛かりな改造が必要となることがしばしば起こる。なお、センサを直付けせずに軸受の近くに配置する場合には、以下の問題がる。
【０００６】振動センサは主に加速度計で構成されており、その検出には方向性があるため、検出対象の軸受から離れた位置に取り付けるとノイズを拾ってしまう。また、温度センサは、熱源から離れれば離れるほど、熱伝導に時間がかかるとともに、他の熱源に影響され正確な値が検出できなくなる。同様に、水分についても軸受のシールドの内側となる軸受空間で湿度を検出しないと、水分浸入の程度を正しく評価できない。
【０００７】そこで本発明では、軸受ハウジングなどの軸受取り付け部に特別な加工を施すことを極力少なくでき、既存設備にも容易に取り付けられるセンサ付き転がり軸受を提供することを目的とする。
【０００８】
【課題を解決するための手段】本発明は、内外の軌道輪と転動体とを備え、検出部と回路部がフレキシブルプリント基板に実装されたセンサを、前記内外いずれかの軌道輪にその周方向に沿わせて取り付ける。または、シールドを備える転がり軸受であって、検出用の回路部をフレキシブルプリント基板に実装して、これをシールドに取り付ける。また、振動または温度或いは湿度の内の少なくともいずれか一つを検出可能な検出部と回路部とを備えたセンサの回路部を、内外いずれかの軌道輪にその周方向に沿わせて取り付ける。このとき湿度を検出する検出部については、前記内外の軌道輪と転動体、及びシールドによって囲まれる空間内に設ける。
【０００９】さらに、センサの検出部によって検出された信号を電波、または超音波に変換して送信できるように、回路部が電波発生部、または超音波発生部を有する構成とするとよい。
【００１０】
【発明の実施の形態】本発明の第１の実施形態について図１（Ａ）（Ｂ）を参照して説明する。図１に示す軸受

1は、単列深溝玉軸受である。この軸受1は、軌道輪の一例である外輪2と内輪3とを備えている。外輪2の内周面側中央部には外輪軌道4が凹設されており、内輪3の外周面側中央部には内輪軌道5が凹設されている。この外輪軌道4と内輪軌道5にそれぞれ転接して、転動体の一例である複数の玉6が保持器7で周方向に等間隔に保持されている。また、外輪2の幅方向両端部2a，2bの内周面側には、シールド取り付け溝8a，8bが設けられており、そこにシールド9が嵌合している。

【0011】外輪2の幅方向片側の外周縁部には、図1（A）、（B）に示すように全周にわたる環状溝10が設けられている。この環状溝10には、外輪2の側面2cを延長した面より内側、かつ、外周面2dを延長した面よりも内側になるように、また、環状溝10の底面10aの周方向に沿って、センサ11が配置されている。このセンサ11は、絶縁性の部材、例えば合成樹脂12でモールドされている。また、温度を計測する場合は、軸受材と熱伝導性がほぼ等しい合成樹脂12を適用することが好ましい。センサ11の防塵・防湿・防油性などを向上させる保護用の合成樹脂12は環状溝10を埋めて環状に設けられ、その側面及び外周面は、前記側面2c及び外周面2dに面一的に連続している。

【0012】振動または、温度を検出するセンサ11は、柔軟性のあるフレキシブルプリント基板（Flexible Printed Circuit以下FPCとする）13に、振動や温度などを検出する検出部15と、検出した信号を出力する回路部16とをなす抵抗、コンデンサ、ICなどの回路部品14等を実装して構成されている。

【0013】本発明の第2の実施形態について図2を参照して説明する。図2に示す軸受21は、外輪22に環状溝を設けず、内輪23の内周縁部の全周にわたる環状溝24を設けている。この環状溝24には、内輪23の側面23aを延長した面よりも内側、かつ、内周面23bを延長した面よりも外側になるように、センサ11を環状溝24の底面24aの周方向に沿わせて配置されている。このセンサ11は、絶縁性の部材、例えば合成樹脂12でモールドされている。センサ11の防塵・防湿・防油性などを向上させる保護用の合成樹脂12は環状溝24を埋めて環状に設けられ、その側面及び内周面は、前記側面23a及び内周面23bに面一的に連続している。また、温度を計測する場合の合成樹脂12は、軸受材と熱伝導性が同じになるようにすることが好ましい。

【0014】その他の構成については第1の実施形態と同じであるので、同一の構成要素については第1の実施形態の該当する構成要素と同一の符号を付してその説明を省略する。

【0015】以上、第1及び第2の実施形態による軸受1，21は、従来のセンサ付き転がり軸受と比較して外側への突出がなくセンサ11を設けることができ、そのため、軸受ハウジングに特別な加工を必要としないのでよい。

【0016】本発明の第3の実施形態について図3を参照して説明する。図3に示す軸受31は、外輪2に設けた環状溝10の底面10aに、センサ11のFPC13を接着面としてセンサ11を直接接着固定している。また、その他の構成については第1の実施形態と同じであるので、同一の構成要素については第1の実施形態の該当する構成要素と同一の符号を付してその説明を省略する。

【0017】本発明の第4の実施形態について図4を参照して説明する。図4に示す軸受41は、内輪23に設けられた環状溝24の底面24aに、センサ11のFPC13を接着面としてセンサ11を直接接着固定している。また、その他の構成については第2の実施形態と同じであるので、同一の構成要素については第2の実施形態の該当する構成要素と同一の符号を付してその説明を省略する。

【0018】以上、第3及び第4の実施形態においても、センサ11を環状溝10または24内に配置したので第1及び第2の実施形態と同様に本発明の課題を解決できる。しかも、第3及び第4の実施形態の軸受31，41のようにセンサ11を接着固定すると、環状溝10，24を充填する合成樹脂をモールドするよりも簡単であるとともに、モールド樹脂が不要で低コストであり、しかも、必要に応じてセンサ11を後から追加することができる。

【0019】なお、第1～第4の実施形態におけるセンサ11の電源は、電源ケーブルによって外部から供給してもよいし、環状溝10，24にセンサ11とともに備えて電力を供給すると、電源ケーブルが不要となるのでなおよい。

【0020】次に、本発明の第5の実施形態について図5を参照して説明する。図5に示す軸受51は、外輪2と内輪3の間に面対向発電機52を備えている。この面対向発電機52は、コイル53と磁石54によって構成されている。コイル53は、環状溝10に対応して外輪2の幅方向端部2aの内周面側に設けられた溝8aに嵌合固定したシールド9の内側（玉6に対向する面）に取り付けられている。また、磁石54は、コイル53に対応して配置されるように、保持プレート55に取り付けられている。この保持プレート55は、内輪3の幅方向端部3aの外周面側に設けられた保持プレート取り付け用溝56に嵌合固定されている。

【0021】そして、この面対向発電機52によって発電される電気は、センサ11に供給される。また、その他の構成については第1の実施形態と同じであるので、同一の構成要素については第1の実施形態の該当する構成要素と同一の符号を付してその説明を省略する。

【0022】このように面対向発電機52を設けると、

センサ１１に電気を外部から供給したり、環状溝１０にセンサ１１とともに電源を納めたりすることが困難な場合でも、センサ１１に電気を供給することが可能である。

【００２３】なお、第５の実施形態においてセンサ１１は、第１の実施形態と同様に外輪２に設けられているが、第２の実施形態のように、内輪２３に設けてもよい。ただし、この場合は、面対向発電機５２のコイル５３を内輪２３に嵌合固定された保持プレート５５に取り付け、磁石５４を外輪２２に嵌合固定されたシールド９に取り付けるものとする。また、第３及び第４の実施形態のように、センサ１１をモールドせず、接着固定してもよい。

【００２４】次に、本発明の第６の実施形態について図６を参照して説明する。図６に示す軸受６１は、固定されたハウジングＨに嵌合固定された外輪６２の側面の一部を切り欠いた凹部６３が設けられている。この凹部６３には、軸受６１の振動や温度などの信号を検出するセンサ６４の検出部１５が取り付けられている。この検出部１５は、外輪６２の側面６２ａを延長した面よりも内側、かつ、外周面６２ｂを延長した面よりも内側になるように配置されている。なお、検出部１５を凹部６３に取りつける方法は、第１や第２の実施形態のように絶縁性の部材、例えば合成樹脂１２でモールドして取り付けてもよいし、第３や第４の実施形態のように、直接凹部６３の底面６３ａに絶縁して接着固定してもよい。また、外輪６２の幅方向両端部６２ｃ，６２ｄに設けられたシールド取り付け溝８ａ，８ｂに嵌合されたシールド９には、センサ６４の回路部１６が絶縁されて直接接着されて取り付けられている。

【００２５】センサ６４は、シールド９の形状に合わせて円弧状に形成されたＦＰＣ６５に回路部品１４等を実装して構成されており、検出部１５と回路部１６が一続きのＦＰＣ６５に備えられている。なお、検出部１５と回路部１６とをそれぞれ独立したＦＰＣに取り付け、配線によって接続してもよい。また、電源は、外部から電線によって供給してもよいし、センサ６４とともにシールド９上に備えると電線ケーブルが不要となるのでなおよいし、第５の実施形態で説明した面対向発電機５４を備えてもよい。そのほかの構成については、第１の実施形態と同じであるので、同一の構成については同一の符号を付して、その説明を省略する。

【００２６】また、センサ６４の取り付け部位は、この実施形態に限定されず、外輪が回転輪となり、内輪が固定輪となる場合においては、内輪３の側面３ａの一部を切り欠いて凹部を設けることで対応できる。この場合は、内輪３の幅方向端部３ｂにシールド取り付け用の溝（凹部）を設け、そこにシールドを嵌合し、センサ６４を取りつけるものとする。

【００２７】このように、第６の実施形態の軸受６１とすると、センサ６４の検出部１５を取り付ける部位を切り欠き加工するだけでよく、軸受６１を取り付けるハウジングＨや軸Ｓの加工が必要ないため、加工を最小限にすることができるセンサ付き軸受６１とすることができる。

【００２８】次に、以上の第１～第６の実施形態における信号の取り出し方法について、図７を参照して説明する。固定輪となる外輪２の振動や温度などを検出する場合、図７に示すようにハウジングＨに第１の実施形態のセンサ付き転がり軸受１を取り付ける。ハウジングＨは固定されているとともに、少なくとも一端が開口されている。回転軸Ｓは、軸受１の内輪３を挿通してこれに固定されており、自由に回転する。固定輪、すなわち外輪２の環状溝１０にモールドによって取りつけられたセンサ１１には、電線Ｗ及び電源ケーブルＥが接続されている。

【００２９】なお、軸受１は、第３の実施形態の軸受３１であってもよい。また、外輪が回転輪となり、内輪が振動や温度などの検出対象となる固定輪となる場合、第２及び第４の実施形態で示した軸受２１，４１を適用し、電線Ｗを接続することで、内輪２３の振動や温度などを検出することができる。

【００３０】また、第６の実施形態の軸受６１の場合においては、シールド９に取り付けたセンサ６４の回路部１６から電線Ｗと電源ケーブルＥを固定側となるハウジングＨあるいは、軸Ｓに沿わせて配線する。

【００３１】これにより、センサ１１，６４の回路部１６によって変換された信号を出力することができる。電線Ｗとともに電源ケーブルＥで電源（図示せず）を外部に設けてもよいし、電源をセンサ１１とともに環状溝１０に（第６の実施形態においては、センサ６４とともにシールド９上に）備えるか、第５の実施形態の軸受５１のように、面対向発電機５２を備えると、電源ケーブルＥは不要となるので、軸受１から延出する配線の数が少なくなりなおよい。

【００３２】本発明の第７の実施形態について図８～図１０を参照して説明する。図８に示すセンサ付き転がり軸受７１は、ハウジングＨに外輪２２が嵌合固定されており、内輪２３に回転軸Ｓが嵌合固定されている。また、ハウジングＨは、少なくとも一端が開口している。軸受７１の回転輪、すなわち内輪２３の環状溝２４に取り付けられたセンサ７２は、振動を検出する検出部１５と、検出した信号を電波Ｒに変換して送信する発信回路部（電波発生部）７３を備えている。また、環状溝２４にはセンサ７２用の電源７４が設けられている。

【００３３】検出部１５は、弾性を有する絶縁部材でできた図９（Ａ）に示す検出部本体１５ａの可動部１５ｃと固定部１５ｄとにそれぞれ相対向する導電性の電極１５ｂが取り付けられたもので、所定の振動加速度を受けることで電極１５ｂ同士が接触するように、可動部１５

cの弾性係数が設定されている。また、発信回路部７３は、図９（Ｂ）にその一例を示すようにコンデンサ７３ａ、コイル７３ｂ、可変抵抗器７３ｃ、可変容量ダイオード７３ｄ等の回路部品１４を備えており、所定の振動加速度を受けて検出部１５の電極１５ｂが互いに接触した場合に、電源７４から発信回路部７３に流れる電流を発振させて、それを電波として出力することができる。

【００３４】また、可変抵抗器７３ｃの抵抗値を変化させて可変容量ダイオード７３ｄに加わる逆電圧を変えると、コンデンサ７３ａと可変容量ダイオード７３ｄの合成容量Ｃが変わり、この合成容量Ｃとコイル７３ｂのリアクタンスしから求まる発振周波数を選択することが可能である。すなわち、複数のセンサ付き転がり軸受７１を同時に使用する場合であっても、それぞれの信号を区別して検出することが可能となる。

【００３５】また、第７の実施形態においては、図１０に示すようにコンデンサ７５ａとコイル７５ｂとを備えた発信回路部７５とし、コンデンサ７５ａの容量とコンデンサ７５ｂのリアクタンスを軸受７１ごとに任意に設定した固定周波数の発信回路部７５とすると、発信回路部７５が小さくなるのでよい。なお、前記構成の発信回路部７３，７５は、発信回路の一例であって、前記構成の回路に限定されない。また、検出部本体１５ａをサーモスタットにすることで所定の温度を検出して電波Ｒを発信するセンサとすることも可能である。なお、ＦＰＣ１３の形状を第６の実施形態のＦＰＣ６５とすると、第６の実施形態の軸受６１に適用できる発信回路部７３，７５を備えたセンサ７２とすることができる。その他の構成については第２の実施形態のセンサ付き転がり軸受２１と同じであるので、同一の構成要素については、第２の実施形態の説明で代用する。

【００３６】この第７の実施形態において、センサ７２を合成樹脂１２でモールドして取り付ける代わりに、第４の実施形態の軸受４１のように、環状溝２４の底面２４ａの周方向に沿わせて接着固定しても良い。また、外輪が振動や温度などの検出対象となる回転輪となり、内輪が固定輪となるような場合においては、第１及び第３または第５の実施形態の軸受１，３１，５１のセンサ１１（第６の実施形態の軸受６１においては、センサ６４）をセンサ７２に置き換えるとともに、軸受１，３１については電源を環状溝１０に（第６の実施形態においては、電源をシールド９上に）備えることで、電波Ｒによって検出した信号を出力できる。なお、送信された信号は、隔離した位置にあるアンテナ７６で受信され、復調器７７を経て、関係する制御系に伝達される。

【００３７】第７の実施形態の軸受７１とすることで、検出した信号を電波Ｒで送信するので、軸受７１から延出配線を無くすことができる。これにより、従来の軸受と同じように取り付けるだけで、軸受の振動や温度などを検出することができるようになる。また、本実施形態によるセンサ付き転がり軸受７１は、回転輪の振動や温度などの検出のみならず、固定輪の振動や温度などの検出にも適用できる。

【００３８】次に、本発明の第８の実施形態について図１１を参照して説明する。図１１に示す軸受８１は、密閉されたハウジングＨ’の内面と外輪２が嵌合固定されており、内輪３に回転軸Ｓが挿嵌固定されている。外輪２には、環状溝１０が設けられており、センサ８２がその底面１０ａの周方向に沿ってモールドされて固定されている。このセンサ８２は、振動や温度などを検出する検出部１５と、検出した信号を超音波Ｕに変換して出力する超音波出力回路（超音波発生部）８３を備えている。なお、ＦＰＣ１３の形状を第６の実施形態のＦＰＣ６５とすると、第６の実施形態の軸受６１に適用できる超音波出力回路部８３を備えたセンサ８２とすることができる。その他の構成については、第５の実施形態の軸受５１と同じであるので、同一の構成要素については、第５の実施形態の説明で代用する。

【００３９】この第８の実施形態において、面対向発電機５２の代わりに、環状溝１０にセンサ８２とともに電源（図示せず）を備えてもよい。また、外輪が回転輪となり、内輪が振動や温度などを検出する対象となる固定輪となる場合においては、軸受８１を第２の実施形態のセンサ付き転がり軸受２１とし、軸受２１のセンサ１１をセンサ８２とし、電源を環状溝２４に備えるか、第５の実施形態のように面対向発電機５２を備えることで、検出した振動や温度などの信号を超音波Ｕによって出力することができる。なお、出力された超音波Ｕは、ハウジングＨ’の外面に設けた超音波検出面に、例えば着脱可能な超音波受信機８４を密着させて超音波Ｕを受信し、復調器８５を経て、関係する制御系に伝達される。

【００４０】このように第８の実施形態のセンサ付き転がり軸受８１とすると、軸受８１がハウジングＨ’によって覆われてしまっている場合においても、センサ８２は振動や温度などの検出した信号を超音波Ｕで出力できる。

【００４１】第１～第５，第７，第８の実施形態のセンサ１１，７２，８２は、環状溝１０，２４の底面１０ａ，２４ａの周方向に沿わせてモールド、または接着固定とし、第６の実施形態のセンサ６４は、検出部１５を軌道輪にモールドまたは接着固定し、回路部１６をシールド９に取り付けたが、いずれの場合においても外輪及び内輪の側面を延長した面と、外輪の外周面を延長した面及び内輪の内周面を延長した面とによって囲まれる範囲よりも内側に、検出部１５が取り付けられているため、ハウジングに特別な加工をしなくてもよい。

【００４２】本発明の第９の実施形態について、図１２（Ａ）～（Ｆ）を参照して説明する。図１２の（Ａ）～（Ｆ）に示すセンサ付き転がり軸受９１は、外輪９２と内輪９３の表面にセンサ１１，６４，７２，８２をその

FPC13，65を接着面として直接貼りつけている。センサ11については第1の実施形態を、センサ64については第6の実施形態を、センサ72については第7の実施形態を、センサ82については第8の実施形態を参照するものとしその説明について省略する。このようにすることで従来のセンサ付き転がり軸受に比べてハウジングの加工量が少ないセンサ付き転がり軸受91とすることが可能である。

【0043】本発明の第10の実施形態について、図13～図15を参照して説明する。なお、第1～第9の実施形態で既に記載の構成要素と同一の構成要素については、同一の符号を付してその説明を省略する。

【0044】図13（A）に示すセンサ付き転がり軸受101は、外輪102、内輪103、及び好ましくは耐水用のシールド104によって囲まれる空間Kの湿度を検出するセンサ105を備えている。この軸受101は、外輪102がハウジングHの開口端に内嵌して固定リング106で固定され、内輪103が回転軸Sの外周面に嵌合して固定されている。外輪102の側面の一部には、図13（B）に示すように外輪102の周方向に沿って凹部107が設けられている。

【0045】センサ105は、検出部108と回路部109を備えており、電源110（例えばボタン形状の電池）から電源ケーブルEによって電力が供給されている。検出部108は、外輪102と嵌合固定され、かつ内輪103と摺接する耐水用のゴム製シールド104の内面104a、すなわち、外輪102、内輪103、シールド104によって囲まれる空間Kの内側に取り付けられている。また、回路部109は、外輪102に設けられた凹部107から突出しないように配置されている。なお、回路部109を取り付けた凹部107を合成樹脂でモールドしてもよい。また、第1～第9の実施形態のセンサ11，64，72，82のように、回路部109をFPCに実装してもよいし、集積回路化するとさらに小型化できるのでよい。

【0046】電源110は、ハウジングHの一部に設けられた凹部111に、絶縁、かつ、防水されて内装されている。また、電源ケーブルEを配設可能に凹部107から凹部111までの間のハウジングHと固定リング106には、溝112a，112bが設けられている。

【0047】センサ105の検出部108は、図14に示すようにくし型の二つの電極113a，113bとこの電極間に設けられた吸湿性の導電体114とを絶縁体の基板115の上に備えており、各電極113a，113bには、端子116a，116bが取り付けられている。なお、この吸湿性の導電体114は、例えば多孔質のセラミック、一例として燐酸カルシウムであって、薄い膜状に塗布焼結乾燥、または真空蒸着などによって取り付けられる。吸湿性の導電体114が空気中の水分を吸収すると、二つの電極113a，113bの間の電気抵抗値が変化する。よって、この検出部108の電気抵抗値の変化を湿度の変化の信号として検出する。そこで、検出部108の一方の電極113aに一定電圧V_{cc}を印加し、接地された抵抗rをもう一方の電極113bに接続する。このようにすることで、検出部108を通過した後の電圧V_1が、湿度に比例する信号として検出される。

【0048】また、図15に示す回路部109は、検出部108によって検出された信号を処理する比較回路部109aと電波発生部である発信回路部109bとを備えている。検出部108を通過した後の電圧V_1をこの比較回路部109aへ比較対象電圧として入力する。また、これとは別に比較回路部109aへ基準電圧V_sを入力する。検出部108が大気中の水分を吸湿し、検出部108の導電体114の電気抵抗値が小さくなると、電圧V_1が相対的に大きくなる。また、基準電圧V_sによって予め設定された閾値と検出部108の吸湿の度合いによって変化する電圧V_1の信号とを比較し、その信号が閾値を超える場合に、発信回路部109bに信号を出力するように比較回路部109aを設定する。これにより、センサ105は、検出した湿度が予め設定された閾値を超えたときに電波を送信する。なお、抵抗rや基準電圧V_sなどを変えることで、閾値を変えることが可能である。前記構成の回路部109は、検出部108の信号を閾値と比較し、外部に設けられる受信機（図示せず）に向けて電波Rを送信する回路部109の一例であって、図15及び前記構成の回路に限定されない。

【0049】以上のように、第10の実施形態によれば、軸受101の外輪102と内輪103及びシールド104によって囲まれる空間の湿度を検出できるとともに、軸受ハウジングHなどの軸受取り付け部の特別な加工を極力少なくでき、かつ、既存設備にも容易に取り付けられるセンサ付き転がり軸受101とすることができる。

【0050】次に、本発明の第11の実施形態について、図16を参照して説明する。なお、第1～第10の実施形態で既に記載の構成要素と同一の構成要素については、同一の符号を付してその説明を省略する。

【0051】図16（A）のセンサ付き転がり軸受121は、外輪122がハウジングHの端部に内嵌固定され、内輪103が回転軸Sの中間部外周面に嵌合して固定されており、湿度を検出するセンサ105を備えている。このセンサ105の回路部109は、耐水用のシールド104の外面104b、すなわち、検出部108が取り付けられた内面104aと反対側の面に取り付けられている。また、図16（B）に示すように回路部109は、検出部108の信号を予め設定された閾値と比較評価する比較回路部109aと、この比較回路部109aによって出力された信号に応じて電波を発信する発信

回路部１０９ｂを備えており、このシールド１０４の周方向に沿って取り付けられている。センサ１０５の検出部１０８と回路部１０９は、耐水性を有してシールド１０４を貫通する電線Ｗで接続されている。また、回路部１０９は、第１～第９の実施形態のセンサ１１，６４，７２，８２のように、ＦＰＣに実装してもよいし、集積回路化するとさらに小型化できるのでよい。

【００５２】また、センサ１０５の電力は、ハウジングＨの凹部１１１に設けられた電源１１０から電源ケーブルＥによって供給されている。この電源ケーブルＥを電源１１０から回路部１０９まで配設するために、溝１１２ａ，１１２ｂがハウジングＨと固定リング１０６とに設けられるほか、外輪１２２の一部に段差１１２ｃが設けられている。なお、電源ケーブルＥが固定リング１０６と干渉しないのであれば、外輪１２２の段差１１２ｃは無くてもよいため、外輪１２２に加工を施すことは無い。

【００５３】以上のように、第１１の実施形態によれば、軸受１２１の外輪１２２と内輪１０３及びシールド１０４によって囲まれる空間Ｋの湿度を検出できるとともに、軸受ハウジングＨなどの軸受取り付け部の特別な加工を極力少なくでき、かつ、既存設備にも容易に取り付けられるセンサ付き転がり軸受１２１とすることができる。また、シールド１０４にセンサ１０５の検出部１０８と回路部１０９とが取り付けられているので、軸受１２１の組立てが容易になる。

【００５４】次に、本発明の第１２の実施形態について、図１７を参照して説明する。なお、第１～第１１の実施形態と同一の構成要素については、同一の符号を付してその説明を省略する。

【００５５】図１７（Ａ）に示すセンサ付き転がり軸受１３１は、第１０及び第１１の実施形態と同様に湿度を検出するセンサ１０５を備えた軸受１３１である。また、図１７（Ｂ）に示すようにセンサ１０５の回路部１０９は、第１１の実施形態と同様に、シールド１０４に取り付けられている。また、第１～第９の実施形態のセンサ１１，６４，７２，８２のように、回路部１０９をＦＰＣに実装してもよいし、集積回路化するとさらに小型化できるのでよい。

【００５６】また電源１１０は、太陽電池である。シールド１０４が固定される軌道輪（この場合は外輪１３２）の一部には、ジールド１０４の外面１０４ｂと同じ面になるように段差１３３が設けられている。そして、この段差１３３とシールド１０４にわたって太陽電池の電源１１０が取り付けられている。なお、太陽電池をシールド１０４の周方向に沿った形状に形成すると、外輪１３２の段差１３３は不要である。

【００５７】以上のように、第１２の実施形態によれば、軸受１３１の外輪１３２と内輪１０３及びシールド１０４によって囲まれる空間Ｋの湿度を検出できるとともに、軸受ハウジングＨなどの軸受取り付け部の特別な加工を極力少なくでき、かつ、既存設備にも容易に取り付けられるセンサ付き転がり軸受１３１とすることができる。また、電源１１０に太陽電池を使用しているので、電池を使用することによって生じる電池切れなどの心配がない。

【００５８】第１０～第１２の実施形態において、センサ１０５の検出部１０８は、外輪１０２，１２２，１３２と内輪１０３、およびシールド１０４によって形成される空間Ｋの外側に配置しているが、その大きさによっては、第９の実施形態の図１２（Ａ）、図１２（ｃ）でのセンサの配置と同様に、空間Ｋの内側に配置してもよく、具体的には空間Ｋに臨む外輪１０２，１２２，１３２の内周面、または空間Ｋに望む内輪１０３の外周面などに配置することができる。また、振動または温度或いは湿度などをそれぞれ検出できるように、検出部１０８を構成してもよい。

【００５９】また、本発明の各実施形態においては、軸受を単列深溝玉軸受としたが、本発明はその他の軸受、例えば円筒ころ軸受、スラスト玉軸受など、全ての軸受に対して適用することができる。

【００６０】

【発明の効果】以上のように、本発明のセンサ付き転がり軸受とすることで、例えば軸受ハウジングなどの軸受取り付け部に特別な加工を施すことが極力少なくて済み、かつ、既存の設備にも容易に取り付けられるセンサ付き転がり軸受とすることができる。また、センサが振動または温度或いは湿度などを検出対象とする軸受に取り付けられているので、軸受に発生した振動や温度や湿度などをいち早く、かつ正確に検出することができる。

【００６１】また、センサに電波発生部、または、超音波発生部を備えることで配線などのわずらわしさが解消され、ハンドリングのよいセンサ付き転がり軸受とすることができる。

【図面の簡単な説明】

【図１】（Ａ）は本発明の第１の実施形態のセンサ付き転がり軸受の断面図。（Ｂ）は図１（Ａ）中のＡ－Ａに沿って示すセンサ付き転がり軸受の断面図。

【図２】本発明の第２の実施形態のセンサ付き転がり軸受の断面図。

【図３】本発明の第３の実施形態のセンサ付き転がり軸受の断面図。

【図４】本発明の第４の実施形態のセンサ付き転がり軸受の断面図。

【図５】本発明の第５の実施形態のセンサ付き転がり軸受の断面図。

【図６】（Ａ）は本発明の第６の実施形態のセンサ付き転がり軸受の断面図。（Ｂ）は図６（Ａ）のセンサ付き転がり軸受の側面図。

【図７】本発明の第１の実施形態のセンサ付き転がり軸

受をハウジング及び回転軸に嵌合した状態を示す断面図。

【図8】本発明の第7の実施形態のセンサ付き転がり軸受の断面図。

【図9】（A）は図8のセンサ付き転がり軸受に取り付けられるセンサの検出部を示す図。（B）は発信回路部とともに図9（A）中のB－Bに沿って示す検出部の断面図。

【図10】図8の転がり軸受のセンサの他の例を示す図9（B）相当の断面図。

【図11】本発明の第8の実施形態のセンサ付き転がり軸受の断面図。

【図12】（A）～（F）は本発明の第9の実施形態に係るそれぞれ異なるセンサ付き転がり軸受の断面図。

【図13】（A）は本発明の第10の実施形態のセンサ付き転がり軸受の断面図。（B）は図13（A）のセンサ付き転がり軸受の側面図。

【図14】図13に示す湿度を検出するセンサの検出部の拡大図。

【図15】図13に示す湿度を検出するセンサのブロック図。

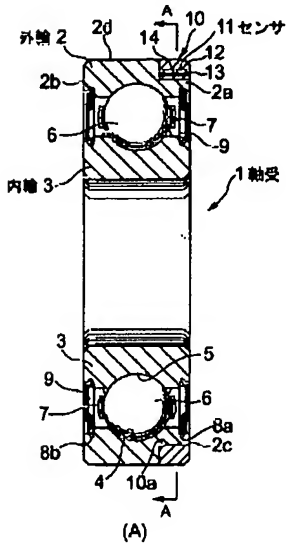
【図16】（A）は本発明の第11の実施形態のセンサ付き転がり軸受の断面図。（B）は図16（A）のセンサ付き転がり軸受の側面図。

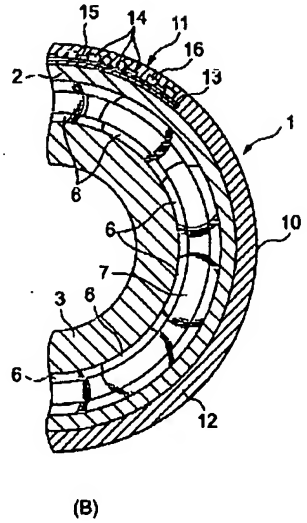
【図17】（A）は本発明の第12の実施形態のセンサ付き転がり軸受の断面図。（B）は図17（A）のセンサ付き転がり軸受の側面図。

【符号の説明】

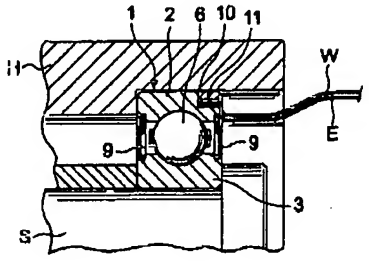
1，21，31，41，51，61…軸受
2，22，62…外輪（軌道輪）
3，23，93…内輪（軌道輪）
6…玉（転動体）
11，64，72，82…センサ
13，65…フレキシブルプリント基板
15…検出部
16…回路部
71，81，91…軸受
73，75…発信回路部（電波発生部）
83…超音波出力回路部（超音波発生部）
92…外輪（軌道輪）
93…内輪（軌道輪）
101，121，131…軸受
102，122，132…外輪
103…内輪
104…シールド
105…センサ
108…検出部
109…回路部
R…電波
U…超音波
K…空間

【図1】

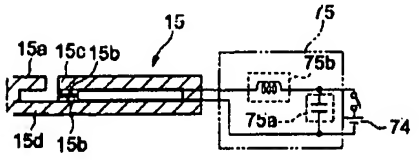




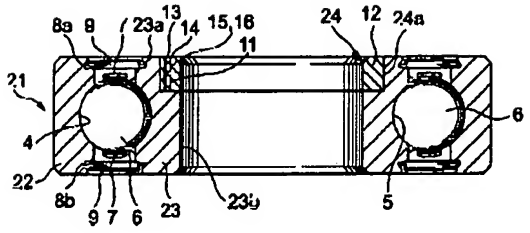
【図7】



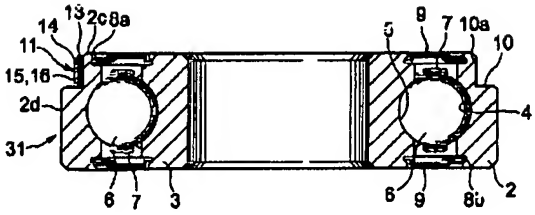
【図10】



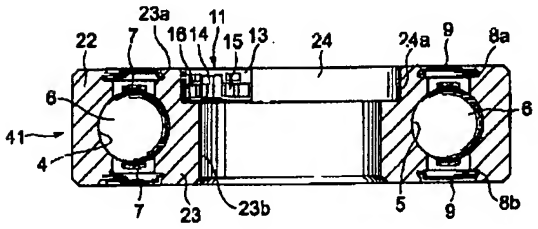
【図2】



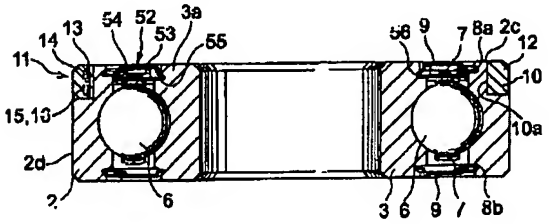
【図3】



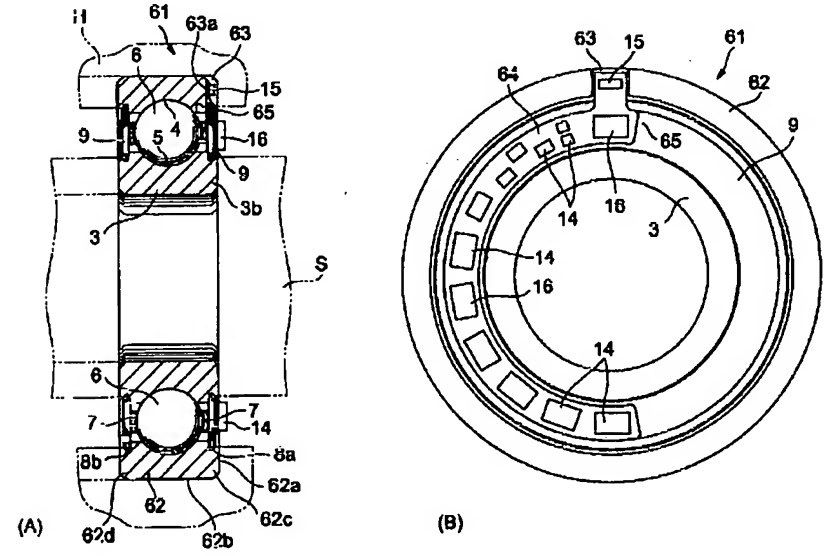
【図4】



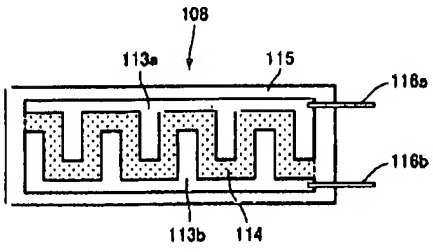
【図5】



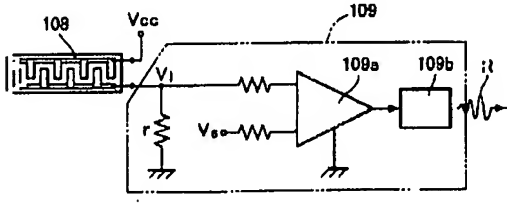
【図6】



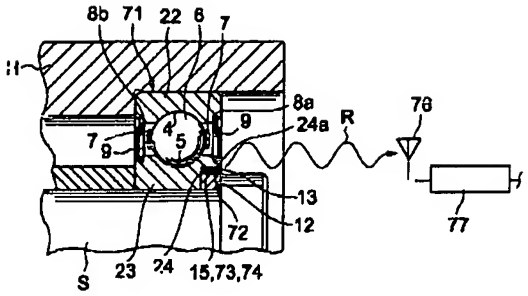
【図14】



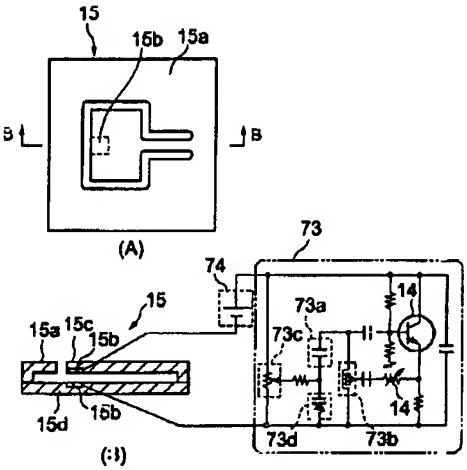
【図15】



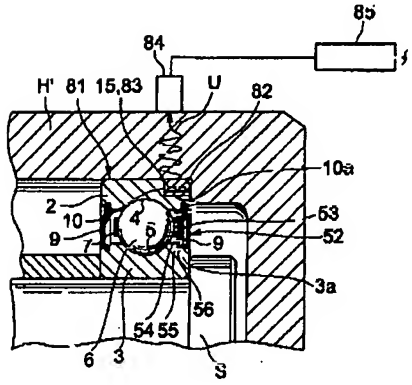
【図8】


8b 71 22 6 7
8a
24a R
78
9
4 5
13
12
72
77
S
23 24 15,73,74

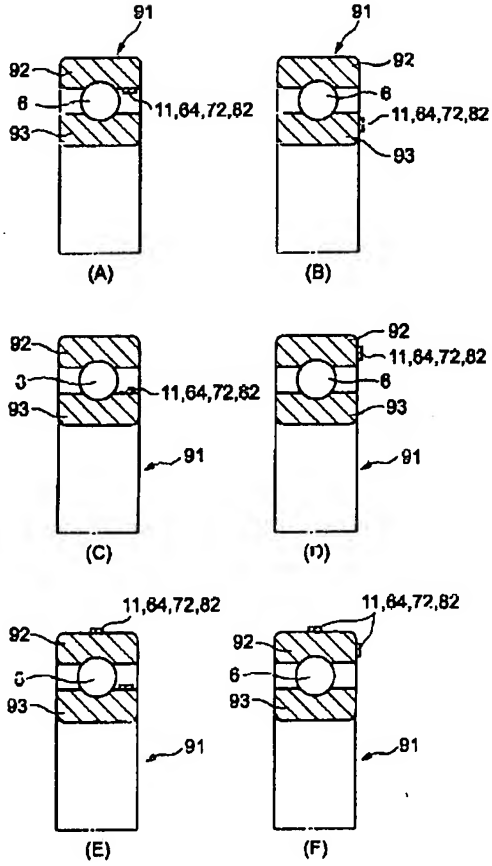
【図9】


15
15b 15a
B
B
(A)
73
74
15
73a
14
15a 15c 15b
73c
15d 15b
14
73d 73b
(B)

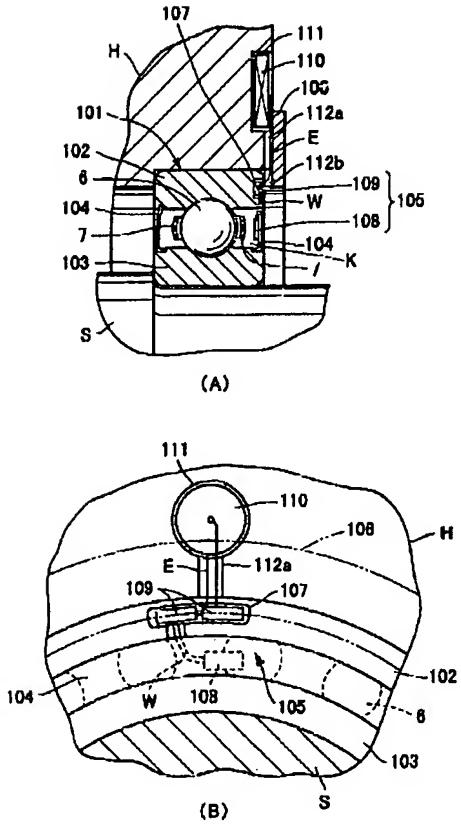
【図11】


85
84
H' 81 15,83 U 82
10a
2
10
4
53
9
5
52
9
7
3a
56
54 55
6 3
S

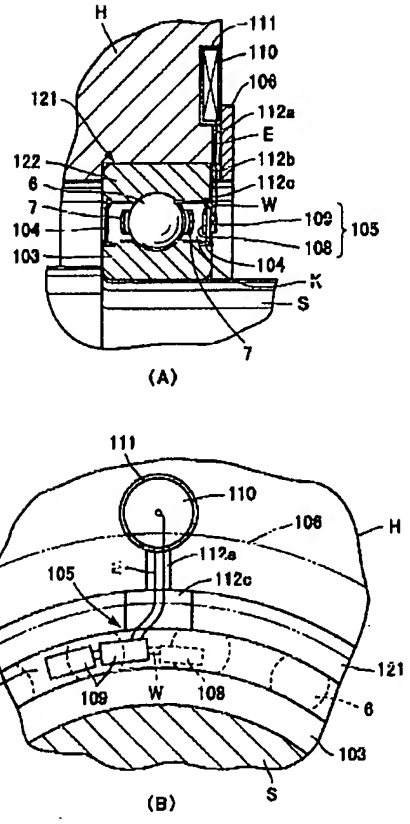
【図12】


91
92
6
93
11,64,72,82
(A)
(B)
(C)
(D)
(E)
(F)

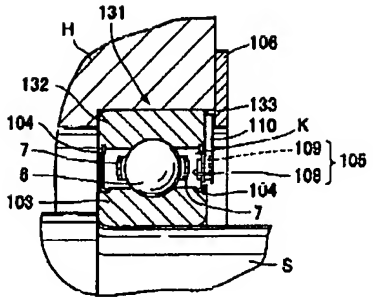
【図13】


107
H
111
110
101
112a
E
102
112b
6
109
105
W
104
108
7
104
103
K
S
(A)
111
110
108
H
E
112a
109
107
102
104
W
108
105
6
103
S
(B)

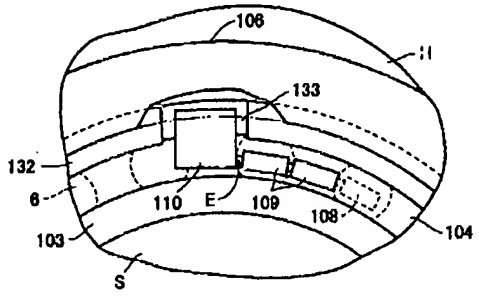
【図16】


H
111
110
121
106
112a
E
122
112b
6
112c
W
7
109
105
104
108
103
104
K
S
7
(A)
111
110
108
H
112a
105
112c
104
121
109
W
108
6
103
S
(B)

【図17】



(A)



(B)

フロントページの続き

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BA54 BA56 BA73 FA21 FA22
FA24 FA26 FA55

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]Anti-friction bearing with a sensor, wherein it had an internal and external bearing ring and a rolling element, and a primary detecting element and a circuit part made one of bearing rings of said inside and outside run along the hoop direction and attach a sensor mounted in a flexible printed circuit board.
[Claim 2]Anti-friction bearing with a sensor being anti-friction bearing provided with a shield, having mounted a circuit part for detection in a flexible printed circuit board, and attaching this substrate to said shield.
[Claim 3]Anti-friction bearing with a sensor having had a sensor which was provided with an internal and external bearing ring and a rolling element, and was provided with a primary detecting element which can detect any at least one of vibration, temperature, or humidity, and a circuit part, having made one of internal and external bearing rings run along the hoop direction, and attaching said circuit part.
[Claim 4]Anti-friction bearing with a sensor given in any 1 paragraph of claim 1 to the claims 3, wherein said primary detecting element which detects humidity is provided in space surrounded with said shield supported by said inside-and-outside bearing ring and one of bearing rings.
[Claim 5]Anti-friction bearing with a sensor given in any 1 paragraph of claim 1 to the claims 4 having an electric wave generating part which said circuit part changes into an electric wave a signal detected by said primary detecting element, and transmits.
[Claim 6]Anti-friction bearing with a sensor given in any 1 paragraph of claim 1 to the claims 4, wherein said circuit part has an ultrasonic generating section which changes into an ultrasonic wave a signal detected by said primary detecting element, and transmits.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to anti-friction bearing with which the sensor which detects vibration, temperature, moisture (humidity), etc. was attached.
[0002]
[Description of the Prior Art]The bearing which supports the axis of rotation produces vibration by gap of a shaft center, or generates heat by rolling friction. Such vibration and temperature influence the life of a bearing. Into an industrial machine, water-soluble lubricant for cutting may be used by machining etc., and the splash which contained moisture in the bearing part may start. When attached to the device used on the outdoors, such as a car, a railroad vehicle, and construction machinery, in it raining or running a puddle etc., water may be poured at a bearing part. Since the rolling contact surface of a bearing ring and a rolling element is rustproofed, for example, it carries out sliding fitting, a gummous waterproof shield is attached and the water proof measure is taken by the internal and external bearing ring at such a bearing part. However, even if it is a bearing with a waterproof shield, by change of the weather, especially a rapid change of atmospheric temperature, inside a waterproof shield, moisture may serve as a steam, may permeate, and may produce dew condensation in the rolling contact surface of a bearing ring and a rolling element.
[0003]Therefore, especially about the bearing attached to the difficult portion of the check inside a device etc., a vibration sensor, a temperature sensor, or a humidity sensor etc. which is a general-purpose article is prepared separately, it is attached to the peripheral face of the target bearing if needed, and the detecting signal is outputted with the cable.
[0004]
[Problem(s) to be Solved by the Invention]However, big projection of a sensor part poses an arrangement top problem easily, and the bearing to which these general-purpose sensors attached it since it was geometrically large requires big processing and space for accommodating a sensor part also in bearing housing in consideration of it.
[0005]In automation of an existing facility, etc., grasp of the operation condition of equipment by remote control is indispensable. Therefore, if it results when attaching a sensor to the bearing of an existing facility and detecting vibration, temperature, moisture (humidity), etc., it often happens that large-scale reconstruction of the circumference of a bearing is needed. The problem of the following when arranging near the bearing, without carrying out direct attachment of the sensor is **.
[0006]Since the vibration sensor mainly comprises an accelerometer and there is directivity in the detection, a noise will be gathered if it attaches to the position which is separated from the bearing for detection. The more a temperature sensor separates from a heat source, while it requires time for heat conduction the more, it is influenced by other heat sources and it becomes impossible to detect an exact value. Unless similarly it detects humidity in the bearing space which serves as the inside of the shield of a bearing also about moisture, the grade of moisture permeation cannot be

evaluated correctly.
[0007]So, in this invention, it can lessen performing processing special to bearing mounting parts, such as bearing housing, as much as possible, and aims at providing anti-friction bearing with a sensor easily attached also to an existing facility.
[0008]
[Means for Solving the Problem]This invention is provided with an internal and external bearing ring and a rolling element, and a primary detecting element and a circuit part make a sensor mounted in a flexible printed circuit board there be along the hoop direction at one of bearing rings of said inside and outside, and attach it. Or it is anti-friction bearing provided with a shield, and a circuit part for detection is mounted in a flexible printed circuit board, and this is attached to a shield. One of internal and external bearing rings is made to run along the hoop direction, and a circuit part of a sensor provided with a primary detecting element which can detect any at least one of vibration, temperature, or humidity, and a circuit part is attached. About a primary detecting element which detects humidity at this time, it provides in said internal and external bearing ring, a rolling element, and space surrounded with a shield.
[0009]It is good for a circuit part to have composition which has an electric wave generating part or an ultrasonic generating section so that a signal detected by primary detecting element of a sensor may be changed into an electric wave or an ultrasonic wave and it can transmit.
[0010]
[Embodiment of the Invention]A 1st embodiment of this invention is described with reference to drawing 1 (A) and (B). The bearing 1 shown in drawing 1 is a single row deep groove ball bearing. This bearing 1 is provided with the outer ring of spiral wound gasket 2 and the inner ring 3 which are examples of a bearing ring. The outer race track 4 is cut in the inner skin side center section of the outer ring of spiral wound gasket 2, and the inner race track 5 is cut in the peripheral face side center section of the inner ring 3. It **** to this outer race track 4 and inner race track 5, respectively, and two or more balls 6 which are examples of a rolling element are held at equal intervals with the cage 7 in the hoop direction. The shield mounting grooves 8a and 8b are established in the crosswise both-ends [of the outer ring of spiral wound gasket 2] 2a, and inner skin side of 2b, and the shield 9 has fitted in there.
[0011]As shown in drawing 1 (A) and (B), the circular sulcus 10 covering the perimeter is established in the outer periphery part of crosswise one side of the outer ring of spiral wound gasket 2. In this circular sulcus 10, the sensor 11 is arranged along the hoop direction of the bottom 10a of the circular sulcus 10 so that it may become the inside [field / which extended the side 2c of the outer ring of spiral wound gasket 2], and inside the field which extended 2 d of peripheral faces. The mold of this sensor 11 is carried out by the insulating member 12, for example, a synthetic resin. When measuring temperature, it is preferred that a bearing material and thermal conductivity apply the almost equal synthetic resin 12. The synthetic resin 12 for protection which raises protection against dust, moisture proof, the oilproofness nature, etc. of the sensor 11 fills the circular sulcus 10, and is provided annularly, and the side and peripheral face are following said side 2c and 2 d of peripheral faces in flat-tapped.
[0012]The primary detecting element 15 which detects vibration, temperature, etc. to the flexible printed circuit board (below Flexible Printed Circuit FPC carries out) 13 in which vibration or the sensor 11 which detects temperature has pliability, Circuit component 14 grades, such as resistance which makes the circuit part 16 which outputs the detected signal, a capacitor, and IC, are mounted, and it is constituted.
[0013]A 2nd embodiment of this invention is described with reference to drawing 2. The bearing 21 shown in drawing 2 did not establish a circular sulcus in the outer ring of spiral wound gasket 22, but has formed the circular sulcus 24 covering the perimeter of the inner periphery edge of the inner ring 23. In this circular sulcus 24, the sensor 11 is made for there to be along the hoop direction of the bottom 24a of the circular sulcus 24, and it is arranged so that it may become the inside

[field / which extended the side 23a of the inner ring of spiral wound gasket 23], and outside the field which extended the inner skin 23b. The mold of this sensor 11 is carried out by the insulating member 12, for example, a synthetic resin. The synthetic resin 12 for protection which raises protection against dust, moisture proof, the oilproofness nature, etc. of the sensor 11 fills the circular sulcus 24, and is provided annularly, and the side and inner skin are following said side 23a and the inner skin 23b in flat-tapped. As for the synthetic resin 12 in the case of measuring temperature, it is preferred to make it a bearing material and thermal conductivity become the same.

[0014]Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.
[0015]As mentioned above, since the bearings 1 and 21 by 1st and 2nd embodiments do not have the projection to the outside as compared with the conventional anti-friction bearing with a sensor, and can form the sensor 11, therefore do not need processing special to bearing housing, they are good.
[0016]A 3rd embodiment of this invention is described with reference to drawing 3. The bearing 31 shown in drawing 3 is carrying out adhesion fixing of the sensor 11 to the bottom 10a of the circular sulcus 10 established in the outer ring of spiral wound gasket 2 directly by making FPC13 of the sensor 11 into an adhesion side. Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.
[0017]A 4th embodiment of this invention is described with reference to drawing 4. The bearing 41 shown in drawing 4 is carrying out adhesion fixing of the sensor 11 to the bottom 24a of the circular sulcus 24 established in the inner ring of spiral wound gasket 23 directly by making FPC13 of the sensor 11 into an adhesion side. Since it is the same as a 2nd embodiment about other composition, the same numerals as the component to which a 2nd embodiment corresponds about the same component are attached, and the explanation is omitted.
[0018]As mentioned above, also in 3rd and 4th embodiments, since the sensor 11 has been arranged in the circular sulcus 10 or 24, the technical problem of this invention is solvable like 1st and 2nd embodiments. And if adhesion fixing of the sensor 11 is carried out like the bearings 31 and 41 of 3rd and 4th embodiments, while it is easier than carrying out the mold of the synthetic resin filled up with the circular sulci 10 and 24, Mold resin is unnecessary, and is low cost, and, moreover, the sensor 11 can be added later if needed.
[0019]If the power supply of the sensor 11 in the 1st - a 4th embodiment may be supplied from the outside, the circular sulci 10 and 24 are equipped with it with the sensor 11 and electric power is supplied with a power cable, since it will become unnecessary [a power cable], in addition, it is good.
[0020]Next, a 5th embodiment of this invention is described with reference to drawing 5. The bearing 51 shown in drawing 5 is provided with the face facing dynamo 52 between the outer ring of spiral wound gasket 2 and the inner ring 3. This face facing dynamo 52 is constituted by the coil 53 and the magnet 54. The coil 53 is attached inside the shield 9 which carried out fit fixing to the slot 8a established in the inner skin side of the width direction end 2a of the outer ring of spiral wound gasket 2 corresponding to the circular sulcus 10 (field which counters the ball 6). The magnet 54 is attached to the holding plate 55 so that it may be arranged corresponding to the coil 53. Fit fixing of this holding plate 55 is carried out to the holding plate attaching slot 56 established in the peripheral face side of the width direction end 3a of the inner ring of spiral wound gasket 3.
[0021]And the electrical and electric equipment generated with this face facing dynamo 52 is supplied to the sensor 11. Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.

[0022]Thus, even when the face facing dynamo 52 is formed and it is difficult to supply the electrical and electric equipment to the sensor 11 from the outside, or to dedicate a power supply to the circular sulcus 10 with the sensor 11, it is possible to supply the electrical and electric equipment to the sensor 11.
[0023]Although the sensor 11 is formed in the outer ring of spiral wound gasket 2 like a 1st embodiment in a 5th embodiment, it may provide in the inner ring 23 like a 2nd embodiment. However, the coil 53 of the face facing dynamo 52 shall be attached to the holding plate 55 by which fit fixing was carried out to the inner ring 23 in this case, and the magnet 54 shall be attached to the shield 9 by which fit fixing was carried out to the outer ring of spiral wound gasket 22. Adhesion fixing of the sensor 11 may be carried out [not carrying out a mold] like 3rd and 4th embodiments.
[0024]Next, a 6th embodiment of this invention is described with reference to drawing 6. The crevice 63 which the bearing 61 shown in drawing 6 cut a part of side of the outer ring of spiral wound gasket 62 by which fit fixing was carried out to the fixed housing H, and was lacked is formed. The primary detecting element 15 of the sensor 64 which detects signals, such as vibration of the bearing 61 and temperature, is attached to this crevice 63. This primary detecting element 15 is stationed so that it may become the inside [field / which extended the side 62a of the outer ring of spiral wound gasket 62], and inside the field which extended the peripheral face 62b. Like the 1st or a 2nd embodiment, the mold of the primary detecting element 15 may be carried out, it may be attached by the insulating member 12, for example, a synthetic resin, and the method of attaching to the crevice 63 may insulate and carry out adhesion fixing to the bottom 63a of the direct crevice 63 like the 3rd or a 4th embodiment. The circuit part 16 of the sensor 64 is insulated by the shield 9 which fitted into the shield mounting grooves 8a and 8b established in the crosswise both ends 62c and 62d of the outer ring of spiral wound gasket 62, it is pasted directly, and it is attached.
[0025]The sensor 64 mounts circuit component 14 grade in FPC65 circularly formed according to the shape of the shield 9, and is constituted, and a series of FPC65 are equipped with the primary detecting element 15 and the circuit part 16. The primary detecting element 15 and the circuit part 16 may be attached to FPC which became independent, respectively, and it may connect with wiring. A power supply may be supplied with an electric wire from the exterior, since an electric wire cable becomes unnecessary to have on the shield 9 with the sensor 64, in addition, it is good, and it may be provided with the face facing dynamo 54 explained by a 5th embodiment. Since it is the same as a 1st embodiment about other composition, the numerals same about the same composition are attached and the explanation is omitted.
[0026]The attachment part of the sensor 64 can respond by cutting and lacking a part of side 3a of the inner ring 3, and providing a crevice, when it is not limited to this embodiment, but an outer ring of spiral wound gasket turns into a turning wheel and an inner ring turns into a fixed wheel. In this case, the slot for shield attachment (crevice) shall be established in the width direction end 3b of the inner ring of spiral wound gasket 3, a shield shall be fitted in there, and the sensor 64 shall be attached.
[0027]Thus, if it is the bearing 61 of a 6th embodiment, what is necessary is just to carry out notching processing of the part to which the primary detecting element 15 of the sensor 64 is attached, and since processing of the housing H and the axis S which attach the bearing 61 is unnecessary, it can be considered as the bearing 61 with a sensor which can make processing the minimum.
[0028]Next, how to take out the signal in the above the 1st - 6th embodiment is explained with reference to drawing 7. When detecting vibration, temperature, etc. of the outer ring of spiral wound gasket 2 used as a fixed wheel, as shown in drawing 7, the anti-friction bearing 1 with a sensor of a 1st embodiment is attached to the housing H. While the housing H is being fixed, the opening of the end is carried out at least. The inner ring of spiral wound gasket 3 of the bearing 1 is inserted in, it is being fixed to this, and the axis of rotation S rotates freely. The electric wire W and power cable E are connected to the sensor 11 attached to the circular sulcus 10 of the fixed wheel 2, i.e., an

outer ring of spiral wound gasket, by the mold.
[0029]The bearing 1 may be the bearing 31 of a 3rd embodiment. When an outer ring of spiral wound gasket turns into a turning wheel and an inner ring turns into a fixed wheel which is the detection targets, such as vibration and temperature, the bearings 21 and 41 shown by 2nd and 4th embodiments can be applied, and vibration of the inner ring 23, temperature, etc. can be detected by connecting the electric wire W.
[0030]In the case of the bearing 61 of a 6th embodiment, from the circuit part 16 of the sensor 64 attached to the shield 9, the electric wire W and power cable E are made to meet the housing H used as a fixed side, or the axis S, and it wires.
[0031]Thereby, the signal changed by the circuit part 16 of the sensors 11 and 64 can be outputted. A power supply (not shown) may be provided outside by power cable E with the electric wire W, and it is to the circular sulcus 10 (in a 6th embodiment) in the sensor 11 about a power supply. Since power cable E will become unnecessary if it has the face facing dynamo 52 like the bearing 51 of a 5th embodiment in preparation for the shield 9 top with the sensor 64, the number of the wiring which extends from the bearing 1 decreases, and, in addition, it is good.
[0032]A 7th embodiment of this invention is described with reference to drawing 8 - drawing 10. Fit fixing of the outer ring of spiral wound gasket 22 is carried out to the housing H, and, as for the anti-friction bearing 71 with a sensor shown in drawing 8, fit fixing of the axis of rotation S is carried out to the inner ring 23. The end is carrying out the opening of the housing H at least. The sensor 72 attached to the circular sulcus 24 of the turning wheel 23 of the bearing 71, i.e., an inner ring of spiral wound gasket, is provided with the primary detecting element 15 which detects vibration, and the dispatch circuit unit (electric wave generating part) 73 which changes the detected signal into the electric wave R, and transmits. The power supply 74 for sensor 72 is formed in the circular sulcus 24.
[0033]The primary detecting element 15 is that to which the conductive electrode 15b which carries out for relativity to the flexible region 15c and the holding part 15d of the primary detecting element main part 15a shown in drawing 9 (A) made in the insulating member which has elasticity, respectively was attached, The elastic coefficient of the flexible region 15c is set up so that electrode 15b may contact by receiving the predetermined acceleration of vibration. As the example is shown in drawing 9 (B), the dispatch circuit unit 73 The capacitor 73a, When it has the circuit components 14, such as the coil 73b, the variable resister 73c, and the variable capacitance diode 73d, and the electrode 15b of the primary detecting element 15 contacts mutually in response to the predetermined acceleration of vibration, the current which flows into the dispatch circuit unit 73 from the power supply 74 can be oscillated, and it can be outputted as an electric wave.
[0034]If the reverse voltage which changes the resistance of the variable resister 73c and is added to the variable capacitance diode 73d is changed, it is possible for the synthetic capacity C of the capacitor 73a and the variable capacitance diode 73d to change, and to choose this synthetic capacity C and the oscillating frequency which can be found from the reactance L of the coil 73b. That is, even if it is a case where two or more anti-friction bearings 71 with a sensor are used simultaneously, it becomes possible to distinguish and detect each signal.
[0035]It is considered as the dispatch circuit unit 75 provided with the capacitor 75a and the coil 75b in a 7th embodiment as shown in drawing 10, If the capacity of the capacitor 75a and the reactance of the capacitor 75b are made into the dispatch circuit unit 75 of the fixed frequency set up arbitrarily every bearing 71, since the dispatch circuit unit 75 will become small, it is good. The dispatch circuit units 73 and 75 of said composition are examples of a dispatch circuit, and are not limited to the circuit of said composition. It is also possible to consider it as the sensor which detects a predetermined temperature by using the primary detecting element main part 15a as a thermostat, and sends the electric wave R. If shape of FPC13 is set to FPC65 of a 6th embodiment, it can be considered as the sensor 72 provided with the dispatch circuit units 73 and 75 applicable to the bearing 61 of a 6th embodiment. Since it is the same as the anti-friction bearing 21 with a

sensor of a 2nd embodiment about other composition, explanation of a 2nd embodiment is substituted about the same component.

[0036]Instead of carrying out the mold of the sensor 72 and attaching it with the synthetic resin 12, like the bearing 41 of a 4th embodiment, the hoop direction of the bottom 24a of the circular sulcus 24 is made to meet, and adhesion fixing may be carried out in this 7th embodiment. In a case so that an outer ring of spiral wound gasket may turn into a turning wheel which is the detection targets, such as vibration and temperature, and an inner ring may turn into a fixed wheel, The sensor 11 (in the bearing 61 of a 6th embodiment) of the bearings 1, 31, and 51 of a 1st and 3rd, or 5th embodiment While transposing the sensor 64 to the sensor 72, it is equipping the circular sulcus 10 with a power supply about the bearings 1 and 31 (setting to a 6th embodiment a power supply on the shield 9), and the signal detected by the electric wave R can be outputted. It is received by the antenna 76 in the isolated position, and the transmitted signal is transmitted to a related control system through the demodulator 77.

[0037]By considering it as the bearing 71 of a 7th embodiment, since the detected signal is transmitted by the electric wave R, extension wiring can be lost from the bearing 71. Vibration, temperature, etc. of a bearing can be detected only by this attaching like the conventional bearing. The anti-friction bearing 71 with a sensor by this embodiment is applicable not only to detection of vibration of a turning wheel, temperature, etc. but detection of vibration of a fixed wheel, temperature, etc.

[0038]Next, an 8th embodiment of this invention is described with reference to drawing 11. Fit fixing of the inner surface and the outer ring of spiral wound gasket 2 of housing H' with which the bearing 81 shown in drawing 11 was sealed is carried out, and fit-in immobilization of the axis of rotation S is carried out at the inner ring 3. The circular sulcus 10 is formed, along the hoop direction of the bottom 10a, the mold of the sensor 82 is carried out to the outer ring of spiral wound gasket 2, and it is being fixed to it. This sensor 82 is provided with the primary detecting element 15 which detects vibration, temperature, etc., and the ultrasonic output circuit (ultrasonic generating section) 83 which changes the detected signal into the ultrasonic wave U, and outputs it. If shape of FPC13 is set to FPC65 of a 6th embodiment, it can be considered as the sensor 82 provided with the ultrasonic output circuit part 83 applicable to the bearing 61 of a 6th embodiment. Since it is the same as the bearing 51 of a 5th embodiment about other composition, explanation of a 5th embodiment is substituted about the same component.

[0039]In this 8th embodiment, the circular sulcus 10 may be equipped with a power supply (not shown) with the sensor 82 instead of the face facing dynamo 52. In the case where an outer ring of spiral wound gasket turns into a turning wheel, and an inner ring turns into a fixed wheel used as the object which detects vibration, temperature, etc., The bearing 81 can be used as the anti-friction bearing 21 with a sensor of a 2nd embodiment, the sensor 11 of the bearing 21 can be used as the sensor 82, and detected signals, such as vibration and temperature, can be outputted with the ultrasonic wave U by having the face facing dynamo 52 for a power supply like a 5th embodiment in preparation for the circular sulcus 24. The outputted ultrasonic wave U sticks the removable ultrasonic receiver 84 to the ultrasonic detection side established in the outside surface of housing H', for example, receives the ultrasonic wave U, and is transmitted to a related control system through the demodulator 85.

[0040]Thus, if it is the anti-friction bearing 81 with a sensor of an 8th embodiment, when the bearing 81 will be covered with housing H', the sensor 82 can output the signal which vibration, temperature, etc. detected by the ultrasonic wave U.

[0041]The sensors 11, 72, and 82 of the 1st - a 5th, 7th, and 8th embodiment, making the hoop direction of the bottoms 10a and 24a of the circular sulci 10 and 24 meet, and considering it as a mold or adhesion fixing -- the sensor 64 of a 6th embodiment -- the primary detecting element 15 -- a bearing ring -- a mold -- or, although adhesion fixing was carried out and the circuit part 16 was attached to the shield 9, Since the primary detecting element 15 is attached inside the range

surrounded by the field which extended the side of the outer ring of spiral wound gasket and the inner ring in the case of which, and the field which extended the field which extended the peripheral face of the outer ring of spiral wound gasket, and family inner skin, it is not necessary to carry out processing special to housing.

[0042]A 9th embodiment of this invention is described with reference to drawing 12 (A) - (F). The anti-friction bearing 91 with a sensor shown in (A) - (F) of drawing 12 is sticking the sensors 11, 64, 72, and 82 on the surface of the outer ring of spiral wound gasket 92 and the inner ring 93 directly by making the FPC 13 and 65 into an adhesion side. A 1st embodiment is abbreviated [sensor / 11] about explanation of Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. to referring to a 7th embodiment for the sensor 72, and referring to an 8th embodiment for the sensor 64 for a 6th embodiment about the sensor 82. The processing amount of housing is able to consider it as little anti-friction bearing 91 with a sensor compared with the conventional anti-friction bearing with a sensor by doing in this way.

[0043]A 10th embodiment of this invention is described with reference to drawing 13 - drawing 15. About the component already same at the 1st - a 9th embodiment as the component of a statement, the same numerals are attached and the explanation is omitted.

[0044]The anti-friction bearing 101 with a sensor shown in drawing 13 (A) is provided with the outer ring of spiral wound gasket 102, the inner ring 103, and the sensor 105 that detects the humidity of the space K surrounded with the desirable shield 104 for water resistance. The outer ring of spiral wound gasket 102 carries out inner fitting to the open end of the housing H, and it is fixed with the stop ring 106, and the inner ring 103 fits into the peripheral face of the axis of rotation S, and this bearing 101 is being fixed. In a part of side of the outer ring of spiral wound gasket 102, as shown in drawing 13 (B), the crevice 107 is established along the hoop direction of the outer ring of spiral wound gasket 102.

[0045]The sensor 105 is provided with the primary detecting element 108 and the circuit part 109, and electric power is supplied by power cable E from the power supply 110 (for example, button-shaped cell). The primary detecting element 108 is attached inside the space K surrounded with the inner surface 104a 102 of the shield 104 made of rubber for water resistance which fit fixing is carried out to the outer ring of spiral wound gasket 102, and ****s to the inner ring 103, i.e., an outer ring of spiral wound gasket, the inner ring 103, and the shield 104. The circuit part 109 is arranged so that it may not project from the crevice 107 established in the outer ring of spiral wound gasket 102. The mold of the crevice 107 to which the circuit part 109 was attached may be carried out with a synthetic resin. Since it can miniaturize further if the circuit part 109 may be mounted in FPC and it integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, it is good.

[0046]It is insulated and waterproofed and the inner package of the power supply 110 is carried out to the crevice 111 established in some housing H. The slots 112a and 112b are established in the housing H and the stop ring 106 of a before [from the crevice 107 / the crevice 111] so that allocation of power cable E is possible.

[0047]The primary detecting element 108 of the sensor 105 has the two comb type electrodes 113a and 113b and the hygroscopic conductor 114 provided in inter-electrode [this] on the substrate 115 of an insulator, as shown in drawing 14, and the terminals 116a and 116b are attached to each electrodes 113a and 113b. This hygroscopic conductor 114 is calcium phosphate, for example as porous ceramics and an example, and is attached by spreading sintering desiccation or vacuum deposition in the shape of [thin] a film. The hygroscopic conductor's 114 absorption of the moisture in the air will change the electric resistance value between the two electrodes 113a and 113b. Therefore, change of the electric resistance value of this primary detecting element 108 is detected as a signal of change of humidity. Then, fixed voltage V_{cc} is impressed to one electrode 113a of the primary detecting element 108, and the grounded resistance r is connected to another

electrode 113b. By doing in this way, voltage V_1 after passing through the primary detecting element 108 is detected as a signal proportional to humidity.

[0048]The circuit part 109 shown in drawing 15 is provided with the comparator circuit part 109a which processes the signal detected by the primary detecting element 108, and the dispatch circuit unit 109b which is electric wave generating parts. Voltage V_1 after passing through the primary detecting element 108 is inputted into this comparator circuit part 109a as comparing target voltage. Reference voltage V_s is inputted into the comparator circuit part 109a apart from this. If the primary detecting element 108 absorbs moisture the moisture in the atmosphere and the electric resistance value of the conductor 114 of the primary detecting element 108 becomes small, voltage V_1 will become large relatively. When the threshold beforehand set up by reference voltage V_s is compared with the signal of voltage V_1 which changes with the degrees of moisture absorption of the primary detecting element 108 and the signal exceeds a threshold, the comparator circuit part 109a is set up output a signal to the dispatch circuit unit 109b. Thereby, the sensor 105 transmits an electric wave, when the detected humidity exceeds the threshold set up beforehand. It is possible to change a threshold by changing the resistance r, reference voltage V_s, etc. The circuit part 109 of said composition is an example of the circuit part 109 which transmits the electric wave R towards the receiver (not shown) in which the signal of the primary detecting element 108 is formed outside as compared with a threshold, and is not limited to drawing 15 and the circuit of said composition.

[0049]As mentioned above, while the humidity of the space surrounded with the outer ring of spiral wound gasket 102, the inner ring 103, and the shield 104 of the bearing 101 is detectable according to a 10th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 101 with a sensor easily attached also to an existing facility.

[0050]Next, an 11th embodiment of this invention is described with reference to drawing 16. About the component already same at the 1st - a 10th embodiment as the component of a statement, the same numerals are attached and the explanation is omitted.

[0051]Inner fitting immobilization of the outer ring of spiral wound gasket 122 is carried out at the end of the housing H, the inner ring 103 is being fitted in and fixed to the pars intermedia peripheral face of the axis of rotation S, and the anti-friction bearing 121 with a sensor of drawing 16 (A) is provided with the sensor 105 which detects humidity. The circuit part 109 of this sensor 105 is attached to the outside surface 104b of the shield 104 for water resistance, i.e., the inner surface 104a and the field of an opposite hand to which the primary detecting element 108 was attached. As shown in drawing 16 (B), the circuit part 109, It has the comparator circuit part 109a which carries out comparative evaluation of the signal of the primary detecting element 108 to the threshold set up beforehand, and the dispatch circuit unit 109b which sends an electric wave according to the signal outputted by this comparator circuit part 109a, and is attached along the hoop direction of this shield 104. The primary detecting element 108 and the circuit part 109 of the sensor 105 are connected with the electric wire W which has a water resisting property and penetrates the shield 104. Since it can miniaturize further if it may mount in FPC and integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, the circuit part 109 is good.

[0052]The electric power of the sensor 105 is supplied by power cable E from the power supply 110 provided in the crevice 111 of the housing H. In order to allocate this power cable E from the power supply 110 to the circuit part 109, the slots 112a and 112b are established in the housing H and the stop ring 106, and also the level difference 112c is formed in a part of outer ring of spiral wound gasket 122. It is not processed into the outer ring of spiral wound gasket 122 in order for there not to be the level difference 112c of the outer ring of spiral wound gasket 122, as long as power cable E does not interfere with the stop ring 106.

[0053]As mentioned above, while the humidity of the space K surrounded with the outer ring of

spiral wound gasket 122, the inner ring 103, and the shield 104 of the bearing 121 is detectable according to an 11th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 121 with a sensor easily attached also to an existing facility. Since the primary detecting element 108 and the circuit part 109 of the sensor 105 are attached to the shield 104, an assembly of the bearing 121 becomes easy.

[0054]Next, a 12th embodiment of this invention is described with reference to drawing 17. About the same component as the 1st - an 11th embodiment, the same numerals are attached and the explanation is omitted.

[0055]The anti-friction bearing 131 with a sensor shown in drawing 17 (A) is the bearing 131 provided with the sensor 105 which detects humidity like 10th and 11th embodiments. As shown in drawing 17 (B), the circuit part 109 of the sensor 105 is attached to the shield 104 like an 11th embodiment. Since it can miniaturize further if the circuit part 109 may be mounted in FPC and it integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, it is good.

[0056]The power supply 110 is a solar cell. In some bearing rings (in this case, outer ring of spiral wound gasket 132) in which the shield 104 is fixed, the level difference 133 is formed so that it may become the same field as the outside surface 104b of the shield 104. And the power supply 110 of the solar cell is attached over this level difference 133 and shield 104. If a solar cell is formed in the shape where the hoop direction of the shield 104 was met, the level difference 133 of the outer ring of spiral wound gasket 132 is unnecessary.

[0057]As mentioned above, while the humidity of the space K surrounded with the outer ring of spiral wound gasket 132, the inner ring 103, and the shield 104 of the bearing 131 is detectable according to a 12th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 131 with a sensor easily attached also to an existing facility. Since the solar cell is used for the power supply 110, there are no worries about the dead battery etc. which are produced by using a cell.

[0058]Although the primary detecting element 108 of the sensor 105 is stationed in the 10th - a 12th embodiment on the outside of the space K formed with the outer ring of spiral wound gasket 102,122,132, the inner ring 103, and the shield 104, Depending on the size, it may arrange inside the space K like arrangement of the sensor in drawing 12 (A) of a 9th embodiment, and drawing 12 (c), and can arrange to the inner skin of the outer ring of spiral wound gasket 102,122,132 specifically facing the space K, or the peripheral face of the inner ring 103 expected to the space K. The primary detecting element 108 may be constituted so that vibration, temperature, or humidity can be detected, respectively.

[0059]In each embodiment of this invention, although the bearing was made into the single row deep groove ball bearing, this invention is applicable to all the bearings, such as other bearings, for example, cylindrical roller bearing, and a thrust ball bearing.

[0060]

[Effect of the Invention]As mentioned above, performing processing special to bearing mounting parts, such as bearing housing, for example can consider it as anti-friction bearing with a sensor attached easily [it is few, and / end and] also for the existing equipment as much as possible by considering it as anti-friction bearing with a sensor of this invention. Since the sensor is attached to the bearing which makes vibration, temperature, or humidity applicable to detection, vibration, temperature, humidity, etc. which were generated in the bearing are promptly and correctly detectable.

[0061]By equipping a sensor with an electric wave generating part or an ultrasonic generating section, troublesomeness, such as wiring, is canceled and it can be considered as good anti-friction bearing with a sensor of handling.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Field of the Invention]This invention relates to anti-friction bearing with which the sensor which detects vibration, temperature, moisture (humidity), etc. was attached.

[Translation done.]

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PRIOR ART

[Description of the Prior Art]The bearing which supports the axis of rotation produces vibration by gap of a shaft center, or generates heat by rolling friction. Such vibration and temperature influence the life of a bearing. Into an industrial machine, water-soluble lubricant for cutting may be used by machining etc., and the splash which contained moisture in the bearing part may start. When attached to the device used on the outdoors, such as a car, a railroad vehicle, and construction machinery, in it raining or running a puddle etc., water may be poured at a bearing part. Since the rolling contact surface of a bearing ring and a rolling element is rustproofed, for example, it carries out sliding fitting, a gummous waterproof shield is attached and the water proof measure is taken by the internal and external bearing ring at such a bearing part. However, even if it is a bearing with a waterproof shield, by change of the weather, especially a rapid change of atmospheric temperature, inside a waterproof shield, moisture may serve as a steam, may permeate, and may produce dew condensation in the rolling contact surface of a bearing ring and a rolling element.
[0003]Therefore, especially about the bearing attached to the difficult portion of the check inside a device etc., a vibration sensor, a temperature sensor, or a humidity sensor etc. which is a general-purpose article is prepared separately, it is attached to the peripheral face of the target bearing if needed, and the detecting signal is outputted with the cable.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, performing processing special to bearing mounting parts, such as bearing housing, for example can consider it as anti-friction bearing with a sensor attached easily [it is few, and / end and] also for the existing equipment as much as possible by considering it as anti-friction bearing with a sensor of this invention. Since the sensor is attached to the bearing which makes vibration, temperature, or humidity applicable to detection, vibration, temperature, humidity, etc. which were generated in the bearing are promptly and correctly detectable.
[0061]By equipping a sensor with an electric wave generating part or an ultrasonic generating section, troublesomeness, such as wiring, is canceled and it can be considered as good anti-friction bearing with a sensor of handling.

[Translation done.]

* NOTICES *

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, big projection of a sensor part poses an arrangement top problem easily, and the bearing to which these general-purpose sensors attached it since it was geometrically large requires big processing and space for accommodating a sensor part also in bearing housing in consideration of it.
[0005]In automation of an existing facility, etc., grasp of the operation condition of equipment by remote control is indispensable. Therefore, if it results when attaching a sensor to the bearing of an existing facility and detecting vibration, temperature, moisture (humidity), etc., it often happens that large-scale reconstruction of the circumference of a bearing is needed. The problem of the following when arranging near the bearing, without carrying out direct attachment of the sensor is **.
[0006]Since the vibration sensor mainly comprises an accelerometer and there is directivity in the detection, a noise will be gathered if it attaches to the position which is separated from the bearing for detection. The more a temperature sensor separates from a heat source, while it requires time for heat conduction the more, it is influenced by other heat sources and it becomes impossible to detect an exact value. Unless similarly it detects humidity in the bearing space which serves as the inside of the shield of a bearing also about moisture, the grade of moisture permeation cannot be evaluated correctly.
[0007]So, in this invention, it can lessen performing processing special to bearing mounting parts, such as bearing housing, as much as possible, and aims at providing anti-friction bearing with a sensor easily attached also to an existing facility.

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MEANS

[Means for Solving the Problem]This invention is provided with an internal and external bearing ring and a rolling element, and a primary detecting element and a circuit part make a sensor mounted in a flexible printed circuit board there be along the hoop direction at one of bearing rings of said inside and outside, and attach it. Or it is anti-friction bearing provided with a shield, and a circuit part for detection is mounted in a flexible printed circuit board, and this is attached to a shield. One of internal and external bearing rings is made to run along the hoop direction, and a circuit part of a sensor provided with a primary detecting element which can detect any at least one of vibration, temperature, or humidity, and a circuit part is attached. About a primary detecting element which detects humidity at this time, it provides in said internal and external bearing ring, a rolling element, and space surrounded with a shield.
[0009]It is good for a circuit part to have composition which has an electric wave generating part or an ultrasonic generating section so that a signal detected by primary detecting element of a sensor may be changed into an electric wave or an ultrasonic wave and it can transmit.
[0010]
[Embodiment of the Invention]A 1st embodiment of this invention is described with reference to drawing 1 (A) and (B). The bearing 1 shown in drawing 1 is a single row deep groove ball bearing. This bearing 1 is provided with the outer ring of spiral wound gasket 2 and the inner ring 3 which are examples of a bearing ring. The outer race track 4 is cut in the inner skin side center section of the outer ring of spiral wound gasket 2, and the inner race track 5 is cut in the peripheral face side center section of the inner ring 3. It **** to this outer race track 4 and inner race track 5, respectively, and two or more balls 6 which are examples of a rolling element are held at equal intervals with the cage 7 in the hoop direction. The shield mounting grooves 8a and 8b are established in the crosswise both-ends [of the outer ring of spiral wound gasket 2] 2a, and inner skin side of 2b, and the shield 9 has fitted in there.
[0011]As shown in drawing 1 (A) and (B), the circular sulcus 10 covering the perimeter is established in the outer periphery part of crosswise one side of the outer ring of spiral wound gasket 2. In this circular sulcus 10, the sensor 11 is arranged along the hoop direction of the bottom 10a of the circular sulcus 10 so that it may become the inside [field / which extended the side 2c of the outer ring of spiral wound gasket 2], and inside the field which extended 2 d of peripheral faces. The mold of this sensor 11 is carried out by the insulating member 12, for example, a synthetic resin. When measuring temperature, it is preferred that a bearing material and thermal conductivity apply the almost equal synthetic resin 12. The synthetic resin 12 for protection which raises protection against dust, moisture proof, the oilproofness nature, etc. of the sensor 11 fills the circular sulcus 10, and is provided annularly, and the side and peripheral face are following said side 2c and 2 d of peripheral faces in flat-tapped.
[0012]The primary detecting element 15 which detects vibration, temperature, etc. to the flexible printed circuit board (below Flexible Printed Circuit FPC carries out) 13 in which vibration or the

sensor 11 which detects temperature has pliability, Circuit component 14 grades, such as resistance which makes the circuit part 16 which outputs the detected signal, a capacitor, and IC, are mounted, and it is constituted.

[0013]A 2nd embodiment of this invention is described with reference to drawing 2. The bearing 21 shown in drawing 2 did not establish a circular sulcus in the outer ring of spiral wound gasket 22, but has formed the circular sulcus 24 covering the perimeter of the inner periphery edge of the inner ring 23. In this circular sulcus 24, the sensor 11 is made for there to be along the hoop direction of the bottom 24a of the circular sulcus 24, and it is arranged so that it may become the inside [field / which extended the side 23a of the inner ring of spiral wound gasket 23], and outside the field which extended the inner skin 23b. The mold of this sensor 11 is carried out by the insulating member 12, for example, a synthetic resin. The synthetic resin 12 for protection which raises protection against dust, moisture proof, the oilproofness nature, etc. of the sensor 11 fills the circular sulcus 24, and is provided annularly, and the side and inner skin are following said side 23a and the inner skin 23b in flat-tapped. As for the synthetic resin 12 in the case of measuring temperature, it is preferred to make it a bearing material and thermal conductivity become the same.

[0014]Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.

[0015]As mentioned above, since the bearings 1 and 21 by 1st and 2nd embodiments do not have the projection to the outside as compared with the conventional anti-friction bearing with a sensor, and can form the sensor 11, therefore do not need processing special to bearing housing, they are good.

[0016]A 3rd embodiment of this invention is described with reference to drawing 3. The bearing 31 shown in drawing 3 is carrying out adhesion fixing of the sensor 11 to the bottom 10a of the circular sulcus 10 established in the outer ring of spiral wound gasket 2 directly by making FPC13 of the sensor 11 into an adhesion side. Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.

[0017]A 4th embodiment of this invention is described with reference to drawing 4. The bearing 41 shown in drawing 4 is carrying out adhesion fixing of the sensor 11 to the bottom 24a of the circular sulcus 24 established in the inner ring of spiral wound gasket 23 directly by making FPC13 of the sensor 11 into an adhesion side. Since it is the same as a 2nd embodiment about other composition, the same numerals as the component to which a 2nd embodiment corresponds about the same component are attached, and the explanation is omitted.

[0018]As mentioned above, also in 3rd and 4th embodiments, since the sensor 11 has been arranged in the circular sulcus 10 or 24, the technical problem of this invention is solvable like 1st and 2nd embodiments. And if adhesion fixing of the sensor 11 is carried out like the bearings 31 and 41 of 3rd and 4th embodiments, while it is easier than carrying out the mold of the synthetic resin filled up with the circular sulci 10 and 24, Mold resin is unnecessary, and is low cost, and, moreover, the sensor 11 can be added later if needed.

[0019]If the power supply of the sensor 11 in the 1st - a 4th embodiment may be supplied from the outside, the circular sulci 10 and 24 are equipped with it with the sensor 11 and electric power is supplied with a power cable, since it will become unnecessary [a power cable], in addition, it is good.

[0020]Next, a 5th embodiment of this invention is described with reference to drawing 5. The bearing 51 shown in drawing 5 is provided with the face facing dynamo 52 between the outer ring of spiral wound gasket 2 and the inner ring 3. This face facing dynamo 52 is constituted by the coil 53 and the magnet 54. The coil 53 is attached inside the shield 9 which carried out fit fixing to the slot 8a established in the inner skin side of the width direction end 2a of the outer ring of spiral wound

gasket 2 corresponding to the circular sulcus 10 (field which counters the ball 6). The magnet 54 is attached to the holding plate 55 so that it may be arranged corresponding to the coil 53. Fit fixing of this holding plate 55 is carried out to the holding plate attaching slot 56 established in the peripheral face side of the width direction end 3a of the inner ring of spiral wound gasket 3.

[0021]And the electrical and electric equipment generated with this face facing dynamo 52 is supplied to the sensor 11. Since it is the same as a 1st embodiment about other composition, the same numerals as the component to which a 1st embodiment corresponds about the same component are attached, and the explanation is omitted.

[0022]Thus, even when the face facing dynamo 52 is formed and it is difficult to supply the electrical and electric equipment to the sensor 11 from the outside, or to dedicate a power supply to the circular sulcus 10 with the sensor 11, it is possible to supply the electrical and electric equipment to the sensor 11.

[0023]Although the sensor 11 is formed in the outer ring of spiral wound gasket 2 like a 1st embodiment in a 5th embodiment, it may provide in the inner ring 23 like a 2nd embodiment. However, the coil 53 of the face facing dynamo 52 shall be attached to the holding plate 55 by which fit fixing was carried out to the inner ring 23 in this case, and the magnet 54 shall be attached to the shield 9 by which fit fixing was carried out to the outer ring of spiral wound gasket 22. Adhesion fixing of the sensor 11 may be carried out [not carrying out a mold] like 3rd and 4th embodiments.

[0024]Next, a 6th embodiment of this invention is described with reference to drawing 6. The crevice 63 which the bearing 61 shown in drawing 6 cut a part of side of the outer ring of spiral wound gasket 62 by which fit fixing was carried out to the fixed housing H, and was lacked is formed. The primary detecting element 15 of the sensor 64 which detects signals, such as vibration of the bearing 61 and temperature, is attached to this crevice 63. This primary detecting element 15 is stationed so that it may become the inside [field / which extended the side 62a of the outer ring of spiral wound gasket 62], and inside the field which extended the peripheral face 62b. Like the 1st or a 2nd embodiment, the mold of the primary detecting element 15 may be carried out, it may be attached by the insulating member 12, for example, a synthetic resin, and the method of attaching to the crevice 63 may insulate and carry out adhesion fixing to the bottom 63a of the direct crevice 63 like the 3rd or a 4th embodiment. The circuit part 16 of the sensor 64 is insulated by the shield 9 which fitted into the shield mounting grooves 8a and 8b established in the crosswise both ends 62c and 62d of the outer ring of spiral wound gasket 62, it is pasted directly, and it is attached.

[0025]The sensor 64 mounts circuit component 14 grade in FPC65 circularly formed according to the shape of the shield 9, and is constituted, and a series of FPC65 are equipped with the primary detecting element 15 and the circuit part 16. The primary detecting element 15 and the circuit part 16 may be attached to FPC which became independent, respectively, and it may connect with wiring. A power supply may be supplied with an electric wire from the exterior, since an electric wire cable becomes unnecessary to have on the shield 9 with the sensor 64, in addition, it is good, and it may be provided with the face facing dynamo 54 explained by a 5th embodiment. Since it is the same as a 1st embodiment about other composition, the numerals same about the same composition are attached and the explanation is omitted.

[0026]The attachment part of the sensor 64 can respond by cutting and lacking a part of side 3a of the inner ring 3, and providing a crevice, when it is not limited to this embodiment, but an outer ring of spiral wound gasket turns into a turning wheel and an inner ring turns into a fixed wheel. In this case, the slot for shield attachment (crevice) shall be established in the width direction end 3b of the inner ring of spiral wound gasket 3, a shield shall be fitted in there, and the sensor 64 shall be attached.

[0027]Thus, if it is the bearing 61 of a 6th embodiment, what is necessary is just to carry out notching processing of the part to which the primary detecting element 15 of the sensor 64 is attached, and since processing of the housing H and the axis S which attach the bearing 61 is unnecessary, it can be considered as the bearing 61 with a sensor which can make processing the

minimum.

[0028]Next, how to take out the signal in the above the 1st - 6th embodiment is explained with reference to drawing 7. When detecting vibration, temperature, etc. of the outer ring of spiral wound gasket 2 used as a fixed wheel, as shown in drawing 7, the anti-friction bearing 1 with a sensor of a 1st embodiment is attached to the housing H. While the housing H is being fixed, the opening of the end is carried out at least. The inner ring of spiral wound gasket 3 of the bearing 1 is inserted in, it is being fixed to this, and the axis of rotation S rotates freely. The electric wire W and power cable E are connected to the sensor 11 attached to the circular sulcus 10 of the fixed wheel 2, i.e., an outer ring of spiral wound gasket, by the mold.

[0029]The bearing 1 may be the bearing 31 of a 3rd embodiment. When an outer ring of spiral wound gasket turns into a turning wheel and an inner ring turns into a fixed wheel which is the detection targets, such as vibration and temperature, the bearings 21 and 41 shown by 2nd and 4th embodiments can be applied, and vibration of the inner ring 23, temperature, etc. can be detected by connecting the electric wire W.

[0030]In the case of the bearing 61 of a 6th embodiment, from the circuit part 16 of the sensor 64 attached to the shield 9, the electric wire W and power cable E are made to meet the housing H used as a fixed side, or the axis S, and it wires.

[0031]Thereby, the signal changed by the circuit part 16 of the sensors 11 and 64 can be outputted. A power supply (not shown) may be provided outside by power cable E with the electric wire W, and it is to the circular sulcus 10 (in a 6th embodiment) in the sensor 11 about a power supply. Since power cable E will become unnecessary if it has the face facing dynamo 52 like the bearing 51 of a 5th embodiment in preparation for the shield 9 top with the sensor 64, the number of the wiring which extends from the bearing 1 decreases, and, in addition, it is good.

[0032]A 7th embodiment of this invention is described with reference to drawing 8 - drawing 10. Fit fixing of the outer ring of spiral wound gasket 22 is carried out to the housing H, and, as for the anti-friction bearing 71 with a sensor shown in drawing 8, fit fixing of the axis of rotation S is carried out to the inner ring 23. The end is carrying out the opening of the housing H at least. The sensor 72 attached to the circular sulcus 24 of the turning wheel 23 of the bearing 71, i.e., an inner ring of spiral wound gasket, is provided with the primary detecting element 15 which detects vibration, and the dispatch circuit unit (electric wave generating part) 73 which changes the detected signal into the electric wave R, and transmits. The power supply 74 for sensor 72 is formed in the circular sulcus 24.

[0033]The primary detecting element 15 is that to which the conductive electrode 15b which carries out for relativity to the flexible region 15c and the holding part 15d of the primary detecting element main part 15a shown in drawing 9 (A) made in the insulating member which has elasticity, respectively was attached, The elastic coefficient of the flexible region 15c is set up so that electrode 15b may contact by receiving the predetermined acceleration of vibration. As the example is shown in drawing 9 (B), the dispatch circuit unit 73 The capacitor 73a, When it has the circuit components 14, such as the coil 73b, the variable resister 73c, and the variable capacitance diode 73d, and the electrode 15b of the primary detecting element 15 contacts mutually in response to the predetermined acceleration of vibration, the current which flows into the dispatch circuit unit 73 from the power supply 74 can be oscillated, and it can be outputted as an electric wave.

[0034]If the reverse voltage which changes the resistance of the variable resister 73c and is added to the variable capacitance diode 73d is changed, it is possible for the synthetic capacity C of the capacitor 73a and the variable capacitance diode 73d to change, and to choose this synthetic capacity C and the oscillating frequency which can be found from the reactance L of the coil 73b. That is, even if it is a case where two or more anti-friction bearings 71 with a sensor are used simultaneously, it becomes possible to distinguish and detect each signal.

[0035]It is considered as the dispatch circuit unit 75 provided with the capacitor 75a and the coil 75b in a 7th embodiment as shown in drawing 10, If the capacity of the capacitor 75a and the

reactance of the capacitor 75b are made into the dispatch circuit unit 75 of the fixed frequency set up arbitrarily every bearing 71, since the dispatch circuit unit 75 will become small, it is good. The dispatch circuit units 73 and 75 of said composition are examples of a dispatch circuit, and are not limited to the circuit of said composition. It is also possible to consider it as the sensor which detects a predetermined temperature by using the primary detecting element main part 15a as a thermostat, and sends the electric wave R. If shape of FPC13 is set to FPC65 of a 6th embodiment, it can be considered as the sensor 72 provided with the dispatch circuit units 73 and 75 applicable to the bearing 61 of a 6th embodiment. Since it is the same as the anti-friction bearing 21 with a sensor of a 2nd embodiment about other composition, explanation of a 2nd embodiment is substituted about the same component.

[0036]Instead of carrying out the mold of the sensor 72 and attaching it with the synthetic resin 12, like the bearing 41 of a 4th embodiment, the hoop direction of the bottom 24a of the circular sulcus 24 is made to meet, and adhesion fixing may be carried out in this 7th embodiment. In a case so that an outer ring of spiral wound gasket may turn into a turning wheel which is the detection targets, such as vibration and temperature, and an inner ring may turn into a fixed wheel, The sensor 11 (in the bearing 61 of a 6th embodiment) of the bearings 1, 31, and 51 of a 1st and 3rd, or 5th embodiment While transposing the sensor 64 to the sensor 72, it is equipping the circular sulcus 10 with a power supply about the bearings 1 and 31 (setting to a 6th embodiment a power supply on the shield 9), and the signal detected by the electric wave R can be outputted. It is received by the antenna 76 in the isolated position, and the transmitted signal is transmitted to a related control system through the demodulator 77.

[0037]By considering it as the bearing 71 of a 7th embodiment, since the detected signal is transmitted by the electric wave R, extension wiring can be lost from the bearing 71. Vibration, temperature, etc. of a bearing can be detected only by this attaching like the conventional bearing. The anti-friction bearing 71 with a sensor by this embodiment is applicable not only to detection of vibration of a turning wheel, temperature, etc. but detection of vibration of a fixed wheel, temperature, etc.

[0038]Next, an 8th embodiment of this invention is described with reference to drawing 11. Fit fixing of the inner surface and the outer ring of spiral wound gasket 2 of housing H' with which the bearing 81 shown in drawing 11 was sealed is carried out, and fit-in immobilization of the axis of rotation S is carried out at the inner ring 3. The circular sulcus 10 is formed, along the hoop direction of the bottom 10a, the mold of the sensor 82 is carried out to the outer ring of spiral wound gasket 2, and it is being fixed to it. This sensor 82 is provided with the primary detecting element 15 which detects vibration, temperature, etc., and the ultrasonic output circuit (ultrasonic generating section) 83 which changes the detected signal into the ultrasonic wave U, and outputs it. If shape of FPC13 is set to FPC65 of a 6th embodiment, it can be considered as the sensor 82 provided with the ultrasonic output circuit part 83 applicable to the bearing 61 of a 6th embodiment. Since it is the same as the bearing 51 of a 5th embodiment about other composition, explanation of a 5th embodiment is substituted about the same component.

[0039]In this 8th embodiment, the circular sulcus 10 may be equipped with a power supply (not shown) with the sensor 82 instead of the face facing dynamo 52. In the case where an outer ring of spiral wound gasket turns into a turning wheel, and an inner ring turns into a fixed wheel used as the object which detects vibration, temperature, etc., The bearing 81 can be used as the anti-friction bearing 21 with a sensor of a 2nd embodiment, the sensor 11 of the bearing 21 can be used as the sensor 82, and detected signals, such as vibration and temperature, can be outputted with the ultrasonic wave U by having the face facing dynamo 52 for a power supply like a 5th embodiment in preparation for the circular sulcus 24. The outputted ultrasonic wave U sticks the removable ultrasonic receiver 84 to the ultrasonic detection side established in the outside surface of housing H', for example, receives the ultrasonic wave U, and is transmitted to a related control system through the demodulator 85.

[0040]Thus, if it is the anti-friction bearing 81 with a sensor of an 8th embodiment, when the bearing 81 will be covered with housing H', the sensor 82 can output the signal which vibration, temperature, etc. detected by the ultrasonic wave U.
[0041]The sensors 11, 72, and 82 of the 1st - a 5th, 7th, and 8th embodiment, making the hoop direction of the bottoms 10a and 24a of the circular sulci 10 and 24 meet, and considering it as a mold or adhesion fixing -- the sensor 64 of a 6th embodiment -- the primary detecting element 15 -- a bearing ring -- a mold -- or, although adhesion fixing was carried out and the circuit part 16 was attached to the shield 9, Since the primary detecting element 15 is attached inside the range surrounded by the field which extended the side of the outer ring of spiral wound gasket and the inner ring in the case of which, and the field which extended the field which extended the peripheral face of the outer ring of spiral wound gasket, and family inner skin, it is not necessary to carry out processing special to housing.
[0042]A 9th embodiment of this invention is described with reference to drawing 12 (A) - (F). The anti-friction bearing 91 with a sensor shown in (A) - (F) of drawing 12 is sticking the sensors 11, 64, 72, and 82 on the surface of the outer ring of spiral wound gasket 92 and the inner ring 93 directly by making the FPC 13 and 65 into an adhesion side. A 1st embodiment is abbreviated [sensor / 11] about explanation of Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. to referring to a 7th embodiment for the sensor 72, and referring to an 8th embodiment for the sensor 64 for a 6th embodiment about the sensor 82. The processing amount of housing is able to consider it as little anti-friction bearing 91 with a sensor compared with the conventional anti-friction bearing with a sensor by doing in this way.
[0043]A 10th embodiment of this invention is described with reference to drawing 13 - drawing 15. About the component already same at the 1st - a 9th embodiment as the component of a statement, the same numerals are attached and the explanation is omitted.
[0044]The anti-friction bearing 101 with a sensor shown in drawing 13 (A) is provided with the outer ring of spiral wound gasket 102, the inner ring 103, and the sensor 105 that detects the humidity of the space K surrounded with the desirable shield 104 for water resistance. The outer ring of spiral wound gasket 102 carries out inner fitting to the open end of the housing H, and it is fixed with the stop ring 106, and the inner ring 103 fits into the peripheral face of the axis of rotation S, and this bearing 101 is being fixed. In a part of side of the outer ring of spiral wound gasket 102, as shown in drawing 13 (B), the crevice 107 is established along the hoop direction of the outer ring of spiral wound gasket 102.
[0045]The sensor 105 is provided with the primary detecting element 108 and the circuit part 109, and electric power is supplied by power cable E from the power supply 110 (for example, button-shaped cell). The primary detecting element 108 is attached inside the space K surrounded with the inner surface 104a 102 of the shield 104 made of rubber for water resistance which fit fixing is carried out to the outer ring of spiral wound gasket 102, and ****s to the inner ring 103, i.e., an outer ring of spiral wound gasket, the inner ring 103, and the shield 104. The circuit part 109 is arranged so that it may not project from the crevice 107 established in the outer ring of spiral wound gasket 102. The mold of the crevice 107 to which the circuit part 109 was attached may be carried out with a synthetic resin. Since it can miniaturize further if the circuit part 109 may be mounted in FPC and it integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, it is good.
[0046]It is insulated and waterproofed and the inner package of the power supply 110 is carried out to the crevice 111 established in some housing H. The slots 112a and 112b are established in the housing H and the stop ring 106 of a before [from the crevice 107 / the crevice 111] so that allocation of power cable E is possible.
[0047]The primary detecting element 108 of the sensor 105 has the two comb type electrodes 113a and 113b and the hygroscopic conductor 114 provided in inter-electrode [this] on the substrate 115 of an insulator, as shown in drawing 14, and the terminals 116a and 116b are attached to each

electrodes 113a and 113b. This hygroscopic conductor 114 is calcium phosphate, for example as porous ceramics and an example, and is attached by spreading sintering desiccation or vacuum deposition in the shape of [thin] a film. The hygroscopic conductor's 114 absorption of the moisture in the air will change the electric resistance value between the two electrodes 113a and 113b. Therefore, change of the electric resistance value of this primary detecting element 108 is detected as a signal of change of humidity. Then, fixed voltage V_{cc} is impressed to one electrode 113a of the primary detecting element 108, and the grounded resistance r is connected to another electrode 113b. By doing in this way, voltage V_1 after passing through the primary detecting element 108 is detected as a signal proportional to humidity.

[0048]The circuit part 109 shown in drawing 15 is provided with the comparator circuit part 109a which processes the signal detected by the primary detecting element 108, and the dispatch circuit unit 109b which is electric wave generating parts. Voltage V_1 after passing through the primary detecting element 108 is inputted into this comparator circuit part 109a as comparing target voltage. Reference voltage V_s is inputted into the comparator circuit part 109a apart from this. If the primary detecting element 108 absorbs moisture the moisture in the atmosphere and the electric resistance value of the conductor 114 of the primary detecting element 108 becomes small, voltage V_1 will become large relatively. When the threshold beforehand set up by reference voltage V_s is compared with the signal of voltage V_1 which changes with the degrees of moisture absorption of the primary detecting element 108 and the signal exceeds a threshold, the comparator circuit part 109a is set up output a signal to the dispatch circuit unit 109b. Thereby, the sensor 105 transmits an electric wave, when the detected humidity exceeds the threshold set up beforehand. It is possible to change a threshold by changing the resistance r, reference voltage V_s, etc. The circuit part 109 of said composition is an example of the circuit part 109 which transmits the electric wave R towards the receiver (not shown) in which the signal of the primary detecting element 108 is formed outside as compared with a threshold, and is not limited to drawing 15 and the circuit of said composition.

[0049]As mentioned above, while the humidity of the space surrounded with the outer ring of spiral wound gasket 102, the inner ring 103, and the shield 104 of the bearing 101 is detectable according to a 10th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 101 with a sensor easily attached also to an existing facility.

[0050]Next, an 11th embodiment of this invention is described with reference to drawing 16. About the component already same at the 1st - a 10th embodiment as the component of a statement, the same numerals are attached and the explanation is omitted.

[0051]Inner fitting immobilization of the outer ring of spiral wound gasket 122 is carried out at the end of the housing H, the inner ring 103 is being fitted in and fixed to the pars intermedia peripheral face of the axis of rotation S, and the anti-friction bearing 121 with a sensor of drawing 16 (A) is provided with the sensor 105 which detects humidity. The circuit part 109 of this sensor 105 is attached to the outside surface 104b of the shield 104 for water resistance, i.e., the inner surface 104a and the field of an opposite hand to which the primary detecting element 108 was attached. As shown in drawing 16 (B), the circuit part 109, It has the comparator circuit part 109a which carries out comparative evaluation of the signal of the primary detecting element 108 to the threshold set up beforehand, and the dispatch circuit unit 109b which sends an electric wave according to the signal outputted by this comparator circuit part 109a, and is attached along the hoop direction of this shield 104. The primary detecting element 108 and the circuit part 109 of the sensor 105 are connected with the electric wire W which has a water resisting property and penetrates the shield 104. Since it can miniaturize further if it may mount in FPC and integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, the circuit part 109 is good.

[0052]The electric power of the sensor 105 is supplied by power cable E from the power supply 110 provided in the crevice 111 of the housing H. In order to allocate this power cable E from the power supply 110 to the circuit part 109, the slots 112a and 112b are established in the housing H and the stop ring 106, and also the level difference 112c is formed in a part of outer ring of spiral wound gasket 122. It is not processed into the outer ring of spiral wound gasket 122 in order for there not to be the level difference 112c of the outer ring of spiral wound gasket 122, as long as power cable E does not interfere with the stop ring 106.
[0053]As mentioned above, while the humidity of the space K surrounded with the outer ring of spiral wound gasket 122, the inner ring 103, and the shield 104 of the bearing 121 is detectable according to an 11th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 121 with a sensor easily attached also to an existing facility. Since the primary detecting element 108 and the circuit part 109 of the sensor 105 are attached to the shield 104, an assembly of the bearing 121 becomes easy.
[0054]Next, a 12th embodiment of this invention is described with reference to drawing 17. About the same component as the 1st - an 11th embodiment, the same numerals are attached and the explanation is omitted.
[0055]The anti-friction bearing 131 with a sensor shown in drawing 17 (A) is the bearing 131 provided with the sensor 105 which detects humidity like 10th and 11th embodiments. As shown in drawing 17 (B), the circuit part 109 of the sensor 105 is attached to the shield 104 like an 11th embodiment. Since it can miniaturize further if the circuit part 109 may be mounted in FPC and it integrated-circuit-izes like the sensors 11, 64, 72, and 82 of the 1st - a 9th embodiment, it is good.
[0056]The power supply 110 is a solar cell. In some bearing rings (in this case, outer ring of spiral wound gasket 132) in which the shield 104 is fixed, the level difference 133 is formed so that it may become the same field as the outside surface 104b of the shield 104. And the power supply 110 of the solar cell is attached over this level difference 133 and shield 104. If a solar cell is formed in the shape where the hoop direction of the shield 104 was met, the level difference 133 of the outer ring of spiral wound gasket 132 is unnecessary.
[0057]As mentioned above, while the humidity of the space K surrounded with the outer ring of spiral wound gasket 132, the inner ring 103, and the shield 104 of the bearing 131 is detectable according to a 12th embodiment, Special processing of bearing mounting parts, such as the bearing housing H, can be lessened as much as possible, and it can be considered as the anti-friction bearing 131 with a sensor easily attached also to an existing facility. Since the solar cell is used for the power supply 110, there are no worries about the dead battery etc. which are produced by using a cell.
[0058]Although the primary detecting element 108 of the sensor 105 is stationed in the 10th - a 12th embodiment on the outside of the space K formed with the outer ring of spiral wound gasket 102,122,132, the inner ring 103, and the shield 104, Depending on the size, it may arrange inside the space K like arrangement of the sensor in drawing 12 (A) of a 9th embodiment, and drawing 12 (c), and can arrange to the inner skin of the outer ring of spiral wound gasket 102,122,132 specifically facing the space K, or the peripheral face of the inner ring 103 expected to the space K. The primary detecting element 108 may be constituted so that vibration, temperature, or humidity can be detected, respectively.
[0059]In each embodiment of this invention, although the bearing was made into the single row deep groove ball bearing, this invention is applicable to all the bearings, such as other bearings, for example, cylindrical roller bearing, and a thrust ball bearing.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1](A) is a sectional view of anti-friction bearing with a sensor of a 1st embodiment of this invention. (B) is a sectional view of anti-friction bearing with a sensor shown along with A-A in drawing 1 (A).
[Drawing 2]The sectional view of anti-friction bearing with a sensor of a 2nd embodiment of this invention.
[Drawing 3]The sectional view of anti-friction bearing with a sensor of a 3rd embodiment of this invention.
[Drawing 4]The sectional view of anti-friction bearing with a sensor of a 4th embodiment of this invention.
[Drawing 5]The sectional view of anti-friction bearing with a sensor of a 5th embodiment of this invention.
[Drawing 6](A) is a sectional view of anti-friction bearing with a sensor of a 6th embodiment of this invention. (B) is a side view of anti-friction bearing with a sensor of drawing 6 (A).
[Drawing 7]The sectional view showing the state where anti-friction bearing with a sensor of a 1st embodiment of this invention was fitted into housing and the axis of rotation.
[Drawing 8]The sectional view of anti-friction bearing with a sensor of a 7th embodiment of this invention.
[Drawing 9](A) is a figure showing the primary detecting element of the sensor attached to anti-friction bearing with a sensor of drawing 8. (B) is a sectional view of the primary detecting element which shows along with B-B in drawing 9 (A) with the dispatch circuit unit.
[Drawing 10]drawing 9 (B) in which other examples of the sensor of anti-friction bearing of drawing 8 are shown -- a considerable sectional view.
[Drawing 11]The sectional view of anti-friction bearing with a sensor of an 8th embodiment of this invention.
[Drawing 12](A) - (F) is a sectional view of anti-friction bearing with a sensor different, respectively concerning a 9th embodiment of this invention.
[Drawing 13](A) is a sectional view of anti-friction bearing with a sensor of a 10th embodiment of this invention. (B) is a side view of anti-friction bearing with a sensor of drawing 13 (A).
[Drawing 14]The enlarged drawing of the primary detecting element of a sensor which detects the humidity shown in drawing 13.
[Drawing 15]The block diagram of the sensor which detects the humidity shown in drawing 13.
[Drawing 16](A) is a sectional view of anti-friction bearing with a sensor of an 11th embodiment of this invention. (B) is a side view of anti-friction bearing with a sensor of drawing 16 (A).
[Drawing 17](A) is a sectional view of anti-friction bearing with a sensor of a 12th embodiment of this invention. (B) is a side view of anti-friction bearing with a sensor of drawing 17 (A).
[Description of Notations]

1, 21, 31, 41, 51, 61 -- Bearing
2, 22, 62 -- Outer ring of spiral wound gasket (bearing ring)
3, 23, 93 -- Inner ring of spiral wound gasket (bearing ring)
6 -- Ball (rolling element)
11, 64, 72, 82 -- Sensor
13, 65 -- Flexible printed circuit board
15 -- Primary detecting element
16 -- Circuit part
71, 81, 91 -- Bearing
73, 75 -- The dispatch circuit unit (electric wave generating part)
83 -- Ultrasonic output circuit part (ultrasonic generating section)
92 -- Outer ring of spiral wound gasket (bearing ring)
93 -- Inner ring of spiral wound gasket (bearing ring)
101,121,131 -- Bearing
102,122,132 -- Outer ring of spiral wound gasket
103 -- Inner ring of spiral wound gasket
104 -- Shield
105 -- Sensor
108 -- Primary detecting element
109 -- Circuit part
R -- Electric wave
U -- Ultrasonic wave
K -- Space

[Translation done.]

* NOTICES *

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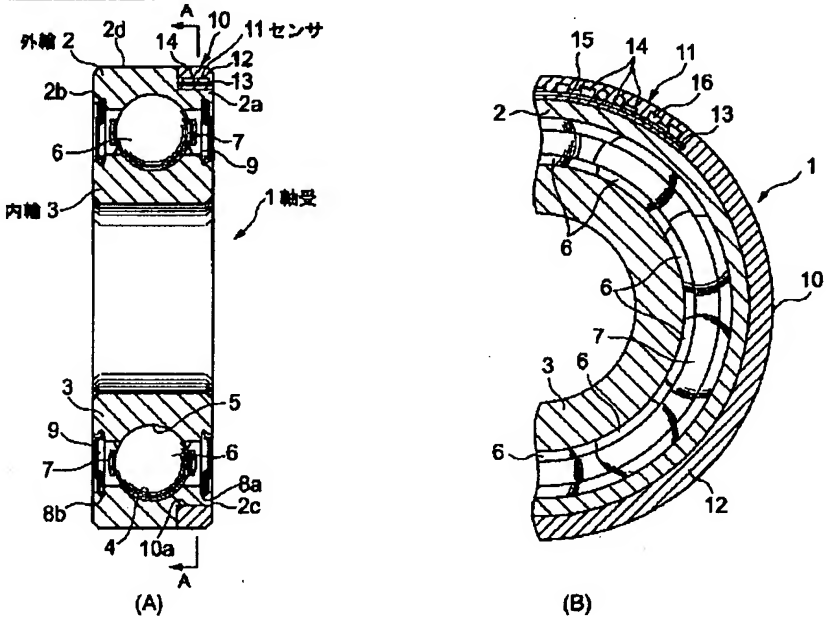
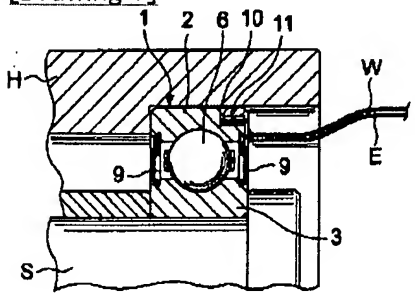
DRAWINGS

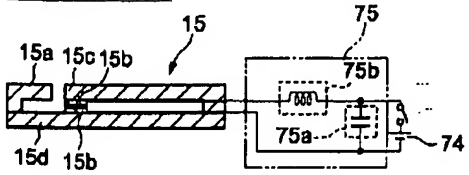
[Drawing 1]



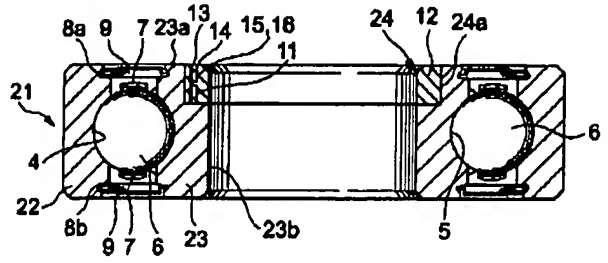
[Drawing 7]



[Drawing 10]



[Drawing 2]



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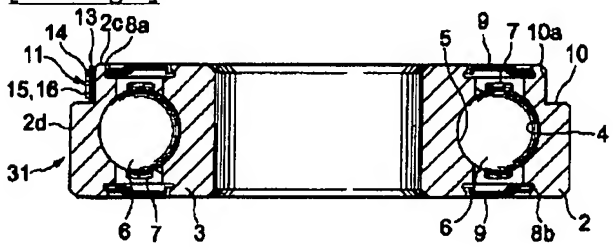
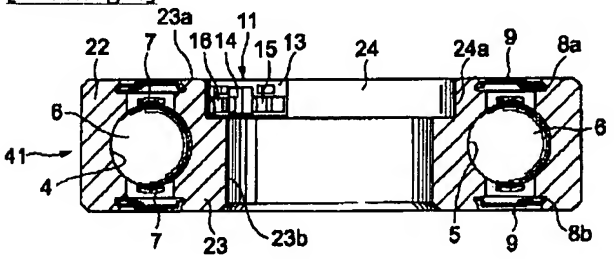
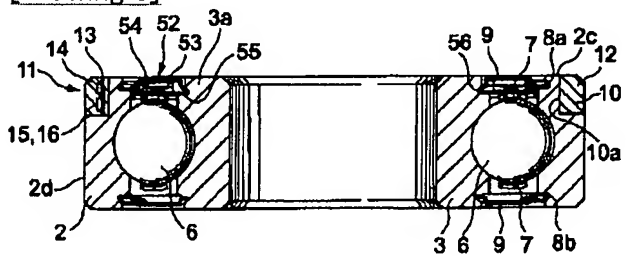


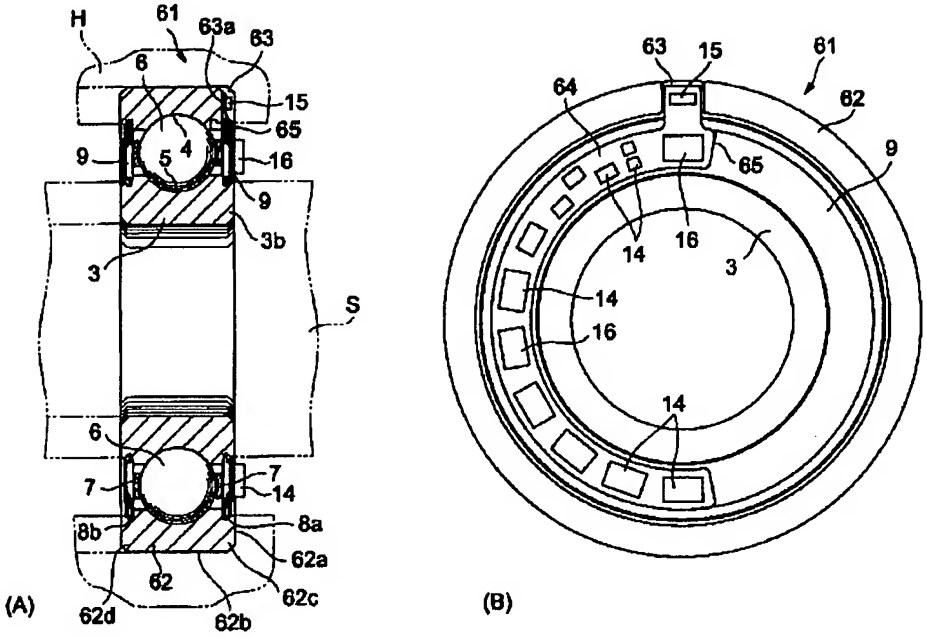
[Drawing 4]



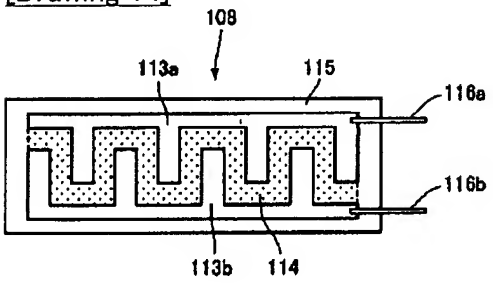
[Drawing 5]



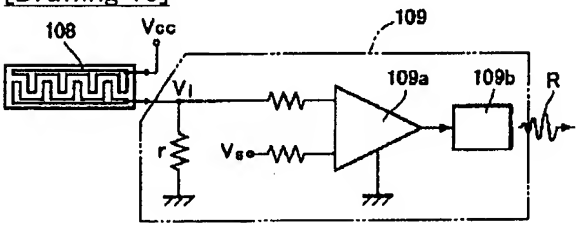
[Drawing 6]



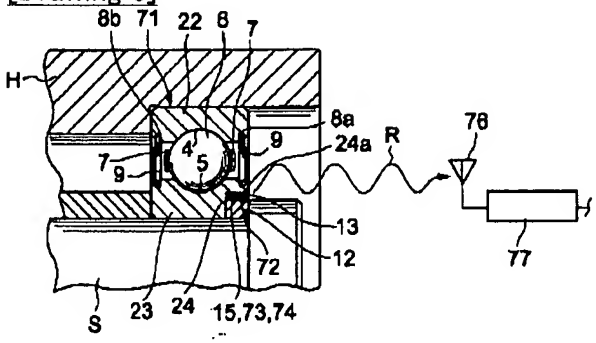
[Drawing 14]



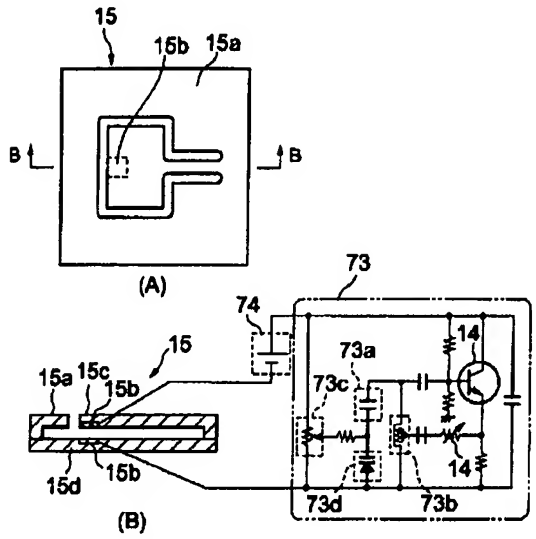
[Drawing 15]



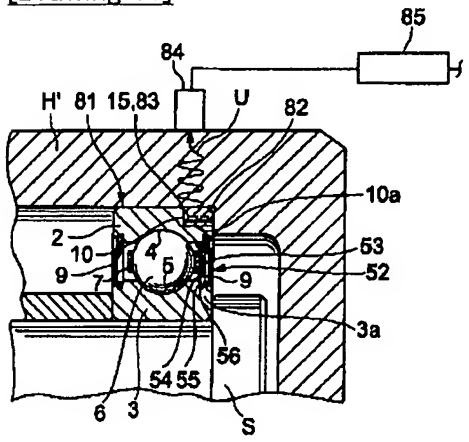
[Drawing 8]



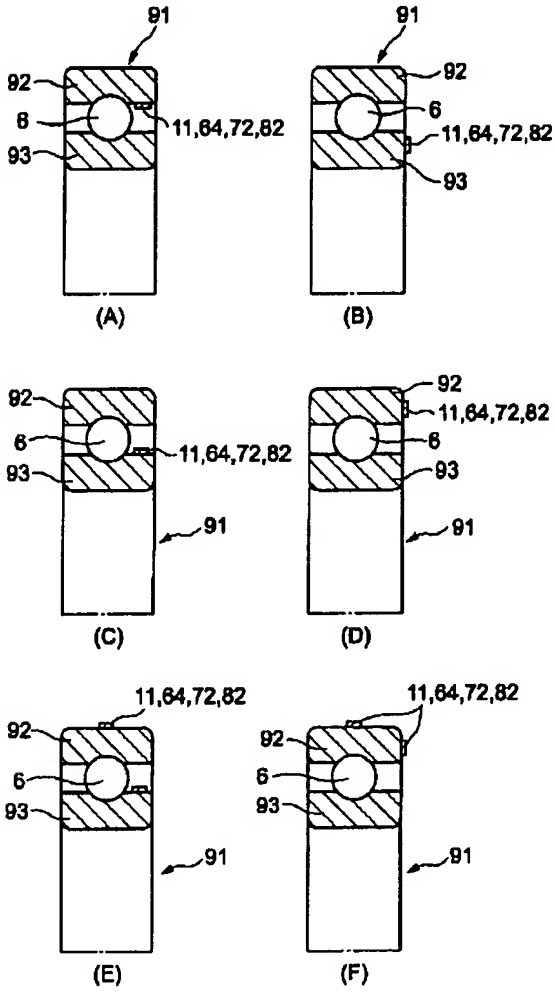
[Drawing 9]



[Drawing 11]



[Drawing 12]


91
92
6
93
11,64,72,82
(A)
91
92
6
11,64,72,82
93
(B)
92
6
93
11,64,72,82
91
(C)
92
11,64,72,82
6
93
91
(D)
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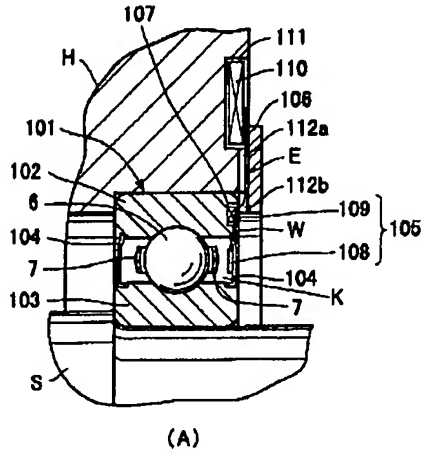
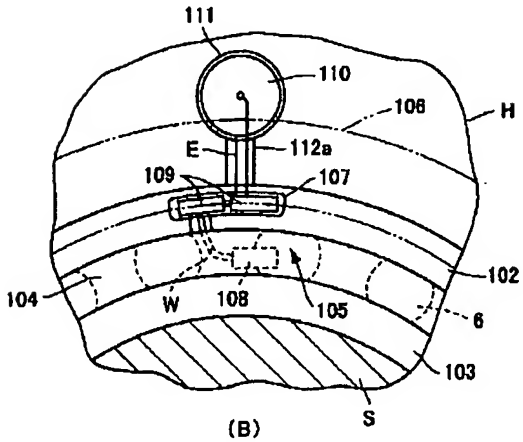
91
(E)
11,64,72,82
92
6
93
91
(F)

[Drawing 13]

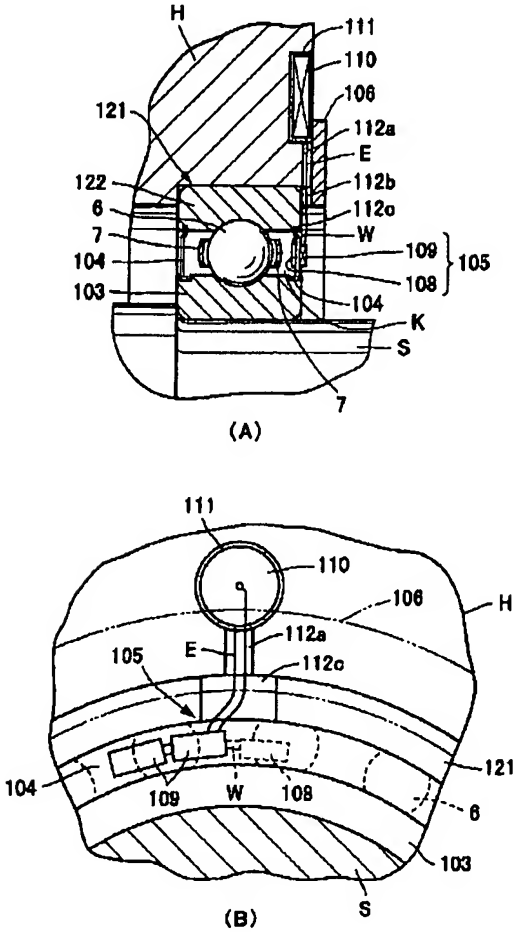


(A)



(B)

[Drawing 16]


H
111
110
106
121
112a
E
122
112b
6
112c
7
W
104
109
105
108
103
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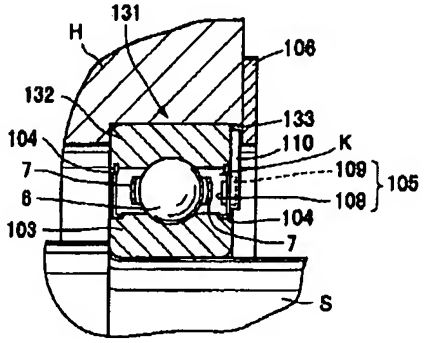
K
S
7
(A)
111
110
106
H
112a
105
E
112c
121
104
109
W
108
6
103
S
(B)

[Drawing 17]



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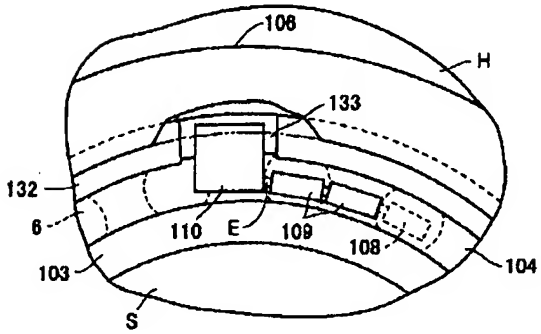

(B)

[Translation done.]